Labor Turnover
When replacements = average no of employed - one complete turnover
Labor Requisition - for more help -
Industrial relations. Employers & Employees relation between workers and management
Standard - unit of measure.

Master Planning - Budget. Plan
Operating ratios - labor cost to selling cost
Statistics - science of the numbers interpreting of figures
Sales Promotion - any thing done to incr

Property of:
Bobbie Hadfield
~~Kathy Stanger~~
Herbie Griffin
"ΣΧ"

Report of
Problem as you analyze it
Decision

ame
oblem - issue etc
nclussion - briefly.

INDUSTRIAL ORGANIZATION

AND

MANAGEMENT

By

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TO

E. L. C.

AND

W. E. C.

PREFACE

This book deals with the fundamental principles and practice of organization and management. It is broad in scope and the content reflects the most recent sound developments in management. It is fully recognized that the problems in one concern are never exactly the same as in another even within the same industry. However, regardless of whether a business is large or small, industrial or commercial, there are certain elements which are essential to its successful operation. Chief among these is the proper application of the basic principles of organization and management. In this study endeavor is made to so present these basic principles and their application that the reader can readily grasp their significance and understand how to intelligently apply them under the varying conditions found in business.

As an intelligent appreciation of even the more simple problems in organization and management requires a certain background of business knowledge, the first chapter is devoted to pointing out the more recent trends in management and to stressing the necessity for studying these trends in order that industrial enterprises may be guided along proper channels. As the degree of success of any business enterprise depends to a very great extent upon the executives, both minor as well as major executives, it is vital that all students of business should appreciate executive responsibility and understand proper executive technique. The second chapter, therefore, is devoted to pointing the way for executive control, thus giving the student a guide as to how an executive should act under various circumstances. The three chapters following present in a clear and simple manner the underlying principles of organization and management and the basic methods of making practical application of them. The foundation having been laid, the next several chapters develop a complete industrial analysis, analyzing the product to be made or service to be rendered, the plant requirements, including plant location, layout, types and construction of buildings, light, heat, ventilation and power, the equipment needed, and the labor, supervision, and management required.

Discussion is then made of each department of a modern industrial concern, emphasis being placed on the organization and management problems confronted and how they may be handled. The treatment is made simple, yet broad and specific, so that the reader may become familiar with the activities and general workings of each department and the relationship which the departments hold one to another and to the business as a whole.

Organization problems and management methods and procedure have been stressed throughout the text. The subject of production control and time study work has been taken up in some detail, developing the basic principles along with illustrations of their application in practice. Following this is a discussion on the foreman and his job, simplification and standardization, management mechanisms, such as wage payment plans and budgets.

This book has been developed primarily for use as a text in schools of commerce and business administration, being based on a course of lectures given by the writer for a number of years as one of the basic courses in the School of Commerce, Accounts, and Finance, New York University. Inasmuch as many graduate engineers enter the production, selling and financial fields, it is hoped that the book will serve equally well as a text in schools of engineering. In fact, it is very generally recognized that a knowledge of management principles and their application is an essential part of the preparation for any business life. Therefore, the text should be of value to all who are or expect to be engaged in business. It is also hoped that the book will serve to bring practical assistance to managers, their assistants and subordinates, so as to be of aid to them in developing effective operating and control methods.

The author is greatly indebted to his wife, Emily L. Cornell, for her continual encouragement and assistance in the preparation of the manuscript; also to his students for the interest they have shown in the subjects covered and especially the working students who, by bringing problems from their everyday business life to class for solution, furnished a number of the illustrations used in the text.

During the preparation of the text, the writer has received valuable assistance from many industrial executives. Wherever possible, mention of the fact has been made in the text. However,

he wishes here to express his appreciation of all aid given to him in any form and especially to Mr. E. F. Roberts, Vice-President in Charge of Manufacturing, and Mr. W. H. Baker, Assistant Chief Inspector of the Packard Motor Car Company, for much of the material in regard to inspection methods as given in the chapter on Inspection; to Mr. E. L. Keenan, Purchasing Agent of Day and Zimmerman, Inc., for forms used and suggestions in connection with purchasing methods as covered in the chapter on the Purchasing Department; to Mr. Edwin Pugsley, Factory Superintendent, Winchester Repeating Arms Company, for many of the forms in connection with the discussion in the chapter on Storeskeeping; to Mr. H. J. Wilson, Works Accountant of the Warner Gear Company, for the forms and much of the material which was used as a basis for the chapters on Scheduling and Dispatching and for helpful criticisms of the several chapters of the manuscript covering the subjects of production control; and to Mr. J. A. Sheldon, Works Manager of Willys-Overland Company, for the illustration from practice of the routine in dispatching.

W. B. Cornell

New York,
September 12, 1928.

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INDUSTRIAL ORGANIZATION AND MANAGEMENT

CHAPTER I

RECENT TRENDS IN MANAGEMENT

Management Before the World War Contrasted with Today.—Scientific management before the World War was in its infancy and where used was restricted mainly to production. The war, with the need for mass production, on what was until then a totally unheard of scale, showed the vital necessity for scientific management and conclusively proved its principles to be fundamental and sound. The World War sounded the knell of the day of management based upon guesswork and placid acceptance of conditions and the rise of that new era of management which emphasizes clearer thinking, careful analysis and a continual striving towards better and better methods and processes.

Interdependence of Business and Management.—Scientific management in production requires that these same principles of growth and progress be applied in all the various phases of business in order to have perfect cooperation and a balanced concern. The finest technique, the most scientifically determined methods and processes, the best equipment and machinery, all are useless without an adequate, carefully selected working force. Likewise, great volume of output is useless unless the goods produced can be sold promptly at a suitable profit. Similarly with all other branches of business activity.

This interdependence of all phases of a business and the need of scientific management, with its coordination of functions and close cooperation became strikingly evident in the trying period of reconstruction immediately following the war. That a scientific attitude on the part of management toward every phase of business is

the correct means for a solution to industrial problems has been fully manifested by the astonishing transformation industry has undergone in these few short years. Industry today is in a fine healthy condition. The wage earner receives more for his labor. The purchasing power of the dollar is greater. The standard of living in the United States is the highest in the world and conditions everywhere point to healthy, substantial progress, not the "flash-in-the-pan" prosperity, but steady and enduring progress. The credit for this marked efficiency in industry with its reduction of needless waste, its higher output per dollar, its low prices and high wages can justly be given to the industrial leaders in modern management. The height of efficiency to which scientific management shall carry industry will be only in proportion to the extent to which its principles are carried. That the science of modern management is being appreciated and put into practice is evident on all sides. The automotive industry has been the pioneer and has carried its efficiency to a point far beyond that of others. The result is the employment in that industry of approximately 3,500,000 persons and an output with a wholesale value of nearly four billions of dollars in one year and steadily increasing. The trend of the day shows other industries following its example.

Effect of the World War.—1. *Overproduction.* As a result of the enormous war time mass production, production at the close of the war in many lines greatly exceeded the normal peace time consumption. Manufacturers of war materials began to adapt their plants to the manufacture in large quantities of products needed in peace time. Likewise, the management of other plants, not realizing the difference between peace time and war time market consumption, continued to operate their enlarged plants to capacity. Everywhere stocks of finished goods piled up and had to be moved. This created keen competition and served to turn the attention of management to sales. A sales demand had to be created to take care of the excess products. At the same time the cost of distribution had to be kept at a minimum. This necessitated putting sales and distribution on a more scientific basis.

2. *High Wages.* During the war, labor was at a premium; wages became high and the problems of the human element in business came to the foreground. These problems could not be solved "off

hand." Each had to be given serious consideration and solved in the light of all influencing factors.

3. *High Costs.* With the high costs and keen competition came a demand that goods be produced and sold cheaper. This necessitated that exact costs be known and laid emphasis upon the necessity for cost accounting and cost reduction.

Some of the More Recent Developments in Manufacturing.—A discussion of the great steps that have been taken in manufacturing within the past ten or twenty years would require volumes, and even then the field would probably not be covered as new ideas, machinery and methods appear almost daily, many of them of great value to the industrial world. The following gives briefly a few of the more marked steps forward and presents a bird's-eye view of the progress that is being made. These are taken up more in detail in subsequent portions of the text.

1. Scientific location of plants is now considered essential. Poor location is frequently one of the main items that enter into high costs and is a prolific source of industrial waste. The trend of the present day is to locate a plant only after a most careful analysis of the requirements of the particular industry and of the individual concern in question.

2. Buildings are constructed and laid out with a view to the particular product to be made, the flow of work through the plant and the safety and comfort of the employees, in contrast to the old way of fitting the business to the building. One of the main factors considered is that which has to do with the handling of materials, emphasis being put upon such layouts as will provide for a minimum of handling operations. This factor on the surface may appear of secondary consideration. Its importance, however, is realized when it is remembered that it is not only the cost of handling, which yearly amounts to an almost unbelievable total, but the even more important item, that of the effect of inefficient handling upon the cost and volume of production. Management has begun to appreciate more fully the possibilities of cost reduction through proper material handling and is bending every effort in that direction.

3. Increased use is made of labor-saving machinery and equipment to further reduce manufacturing costs. By the substitution of efficient mechanical devices for costly hand labor, labor costs are mate-

rially reduced, the productive power of the worker is multiplied and the product turned out is frequently of higher grade.

4. Standardization and simplification both in design and in the use of materials is one of the marked steps forward. The waste incurred through the multiplicity of designs and materials in industry is almost inconceivable. Considerable progress has been made in a number of industries in reducing the number of varieties produced and in the standardization of materials and design, but there still remains much to be done along this line.

5. Time and motion studies are used to determine the best way of doing a job and the proper elapsed time to complete that job in this one best way. These data are then used in the setting of standards and as a basis in determining adequate and fair wages and incentives, the wages paid being in direct relation to the work accomplished. Time study work, contrary to popular belief, is not merely for the setting of piece-work rates but for general improvement and control.

6. Centralized planning covers the routing, scheduling and dispatching of work through the plant. Modern industrial executives insist that accurate records of performance be kept so that these can be used as a trustworthy guide in planning for future activities. The extent to which routing, scheduling and dispatching (and in fact, all preplanning before actual doing) can be carried, depends upon conditions in the particular plant.

7. Until recently, purchasing was considered simply as a question of sharpness of wits, and the purchasing agent merely as a keen and sharp bargainer. Today purchasing is on a scientific basis. The quality of the material to be ordered is usually covered by specifications and the order is given to the firm that submits the lowest bid, provided they are of established reputation and prompt and efficient service can be depended upon.

8. Scientific control of stores provides one of the main links in the modern chain of material control. It safeguards capital in the form of materials. It further aids in accounting for stores and in maintaining at a minimum investment stocks consistent with current production requirements.

9. The necessity of knowing true costs and the use of accurate cost figures as a mechanism of management is now recognized. Elaborate cost systems have been in use for a number of years, but,

unfortunately, the findings in a great many cases have merely been pigeonholed. The systems have been either too cumbersome for efficient use, or management has been at fault in considering the reports simply as records of past performance rather than as trustworthy guides to be used as a basis for managerial control. Cost systems by themselves are inadequate. They show conditions as they are so that weak places can readily be detected, but they do not correct the condition. Management must organize this valuable cost data and use them as a basis for control and cost reduction. It is up to management to find the means to correct the conditions brought to light by the cost figures. This everyday use of cost figures and a continual effort at cost reduction is one of the aims of present-day management.

Extension of Scientific Management to the Worker.—One of the most significant developments in management is the interest that is being shown in the human factor in industry. During the World War the abnormal industrial activity created a labor shortage which threw executives into something bordering upon panic, so that they quickly grasped all sorts of personnel "cure-alls" that were offered to them. Many, if not most, of these schemes to attract and hold labor were undertaken without due consideration of the needs or desires of the worker, with the result that they were looked upon as charity offerings, something no self-respecting worker wants. The welfare efforts often were a costly failure, doing more harm than good. Personnel work fell into disrepute for a time, but due to the continued efforts of broadminded industrial leaders of vision, personnel work is again coming to the front—not as a panacea of industrial ills but as the sincere effort on the part of management to win the confidence of labor and to bring about a mutual respect and willingness to cooperate between management and workers. When adequate attention is given to the human element in business, and personnel work is planned not as an emergency measure but as a conscientious effort to bring management and labor together with mutual understanding, then much of the friction, labor troubles and radical tendencies disappear of themselves. This is the present-day tendency in personnel work, and while it does not have the sensational characteristics of war time so-called "welfare work," it cannot help but have lasting and far-reaching power for good for both management

and labor. The following are among the phases of industrial relations work now receiving considerable attention.

1. *Selective Employment.* "The Right Man in the Right Place." This requires scientific treatment of the employment problem which covers hiring of new employees and transfer of old employees to other departments where they are better fitted to succeed. When properly followed, selective employment results in contented, efficient workers with equal benefit to employer and employee. The employee, being fitted for his work, enjoys it, performs his duties well, and is relieved of the worry over possible loss of employment. The company profits from the increased efficiency of its workers and the decreased cost of labor turnover.

2. *Importance of the Foreman.* Stress is laid upon the importance of the selection and training of the foremen—the "key men." Foremen are now recognized as holding a strategic position. They represent the management to the worker and are responsible to the management for carrying out its policies and instructions. A company may have the fairest of labor policies and may institute a splendid program of personnel work and yet have its efforts nullified by the attitude or actions of incompetent foremen or those working at cross-purposes to the plans of the company. Modern industrial concerns select as foremen men who through personality, training and experience are particularly fitted for that position. In many instances special training is given to foremen and prospective foremen in order to broaden their viewpoint, to make them fully conversant with company plans and policies and in general capable of performing the duties of their position.

3. *Employee Training.* The size of the plant, the character of the work, the available labor supply, these and other factors enter into the question as to what extent it is advisable to carry a program of employee training. The average employee with a little encouragement and practical help will exert his utmost toward self-improvement, thereby promoting his own growth and at the same time making of himself a more valuable employee. Employee training to be of greatest value must be given with due regard to the needs of the individual, as well as to the requirements of that particular class of employees of which he is a part.

4. *Better Working Conditions.* Proper working conditions in-

sure the health and comfort of the workers, thereby aiding in stabilizing the labor force and in reducing waste due to lost time.

5. *Hours of Work and Wages Paid.* Adequate compensation for the work accomplished and a reasonable number of working hours are recognized as essentials in gaining the necessary cooperation between employer and employees. While to the average worker security in his job is the first essential, still he will not be content or efficient if he is not paid a wage commensurable with his efforts. The ambitious worker wants fair payment for services rendered and the opportunity for advancement. Modern management realizes that it is the ambitious worker who makes the profits and not the rut-bound one. In many concerns financial incentives are given for increased productive effort, and on all sides the tendency is to have, as far as possible, wages paid in direct relation to work accomplished.

6. *Joint Relations.* Under the heading of joint relations is here included such phases of personnel work as employee representation and the handling of complaints and grievances. The average employee has no desire to participate in the active management of the concern but he does wish a voice in those matters which directly concern him. Such participation in company affairs tends to bring out the best in the worker and serves to broaden and develop him and to materially increase his loyalty to his company. The handling of complaints and grievances through some form of employee representation or by a personnel department takes disruptive questions from the hands of the foreman, assures fair treatment to all concerned, and does much in doing away with radical tendencies and unrest among the workers. When personnel work is on a good common sense basis under the direction of an executive of mature judgment, with a broad knowledge of men and affairs, it is invariably found to be a paying proposition in dollars and cents saved to the company.

Developments in Distribution.—Due to keen competition the continued prosperity of the average business depends to a considerable extent upon its sales function, and yet marketing has been touched least by scientific management. The results so far obtained, however, have been of considerable value and in time possibly may be as successful and as far reaching as in the field of production.

The modern method is to have direct selling backed up by scientific advertising and sales promotion work, the work of all three being tied together through the use of control records. Under scientific sales management the following are among the essentials considered:

1. A study of the product from the retail sales or merchandising standpoint as regards competition, methods of marketing, price, etc. Each product is carefully analyzed to see what changes could be made to make it more fully meet present retail sales requirements and to open new fields of use. The concern that senses impending changes in public needs and desires and prepares to meet them without unduly increasing costs due to excess varieties will remain always as a leader in its field. Public wants are continually changing, and the concern that does not keep abreast of the times is doomed to failure. Likewise, however, is the concern that caters to every whim and fancy, regardless of the increase in costs. A middle course must be taken. Excess variety must be eliminated, leaving a reasonable number of standards with just enough leeway to permit of meeting public demand.

2. Analysis of the market. Statistics are carefully compiled and studied covering competition, relative purchasing power and sales possibilities of different districts, transportation facilities and various items which enter into the cost of making sales. A complete analysis is made of each territory before deciding whether to enter it and to what extent and how the territory should be worked. Such a survey will determine the approximate value of the market and the portion of the total volume that the particular concern can hope to get. In many instances subsequent sales records have shown that such market analyses are surprisingly accurate. An analysis is also made of present sales territories to determine the extent to which it is profitable to develop the territory.

3. Study of the methods of distribution to determine the most efficient method of distribution of products. Owing to the excessive high cost of making sales, much thought has been given to this phase of sales work. So far no satisfactory method has been devised to materially reduce the cost of selling and still have a wide distribution of products. Some industries sell direct to the consumer, but the majority of concerns have found it advisable to still keep to the old method of distribution through jobbers and dealers.

Advertising and sales promotion work are playing an increasingly important part in modern sales work.

4. The use of a sales budget. The use of a sales budget is a marked step forward. It is used not only to stimulate the sales force and aid in the control of sales but also to facilitate production, purchasing and financing. The sales budget is the keystone in any budgetary program, as it is chiefly upon the expectation of sales that plans for the budget period are made. Budgets are one of the most efficient mechanisms of management, permitting of adequate control through the laying of careful plans for the future and the check of actual performance against estimates made, holding those in authority responsible for the results as shown.

Modern Conduct of Business.—The reason back of all the above trends in manufacturing and distribution is the more analytical and broader attitude of management toward business and the recognition of the fact that no matter how good a method, system, process or product may be, there can always be improvement made, always something better. It is recognized that new and difficult problems are constantly arising and will continue to arise and so must be met, that business data must be collected, analyzed and studied. The improvement resulting from such a scientific attitude toward business is unquestionably shown in the present conduct of business, in the relative stability of industrial activities and the greater output per dollar of capital and labor expended.

CHAPTER II

EXECUTIVES

The Need of Business.—With the rapid expansion of business and the growing appreciation of the necessity for scientific management came increased demand for men of executive ability. The great need in business today is for bigger men—broadminded men trained in the science of management. The modern problem is not so much that of supply of money and credit, labor and materials, but of executives—men of intelligence and of progress who can be trusted to build, guide and control industries. These makers of modern industrial history must be chosen from among men of vision, men who are not content to stay in a rut but who see opportunities ahead and prepare themselves so that they will be in position to grasp them when they arise. They must be men who do not know the word "impossible" except as an impediment to progress, one more obstacle to be overcome. They must be men who have risen above the narrow confines of self-interest and personal prejudice, men who lend their every effort in the interest of their work and in the accomplishment of a purpose.

The basis of the present-day, far-reaching progress in industry is the ideas and efforts of industrial executives. Only too frequently the plant and its equipment and the stock on hand are looked upon as the concern. True, this is the valuable material side, but back of all is the management—the executives who guide and control and without whom the plant would soon be valueless as a productive unit. Andrew Carnegie once said, "Take away all our factories, our trade, our avenues of transportation, our money, but leave me our organization and in four years I will have reestablished myself."

Who Are Executives?—In speaking of executives it is well to bear in mind just what the term executive implies. The word executive includes more than the general manager and the various department heads. An executive is anyone who is responsible for the direction and control of others and for the execution of the work

performed by them. There are no rules which can be given to insure success as an executive. There are, however, certain traits and manners of conduct which are essential to executive success. A few fundamental characteristics must be inborn, but others may be developed. Inherent ability does not insure success. Natural powers and capacity must be organized, utilized and developed.

A regard for the rights of others, a good personality and a trained mind are essential. The executive must be a believer in others, not a chronic fault-finder, nor should he "carry a chip on his shoulder." He must look beyond criticism and complaints and see the true conditions. He must respect the rights and aspirations of others. He must be able to bring out the best in others. This he cannot do unless he has a sincere affection for them. The true executive knows his men, their strength and weakness. He knows the possibilities and capabilities of those associated with him. He keeps in close touch with his workers and makes them feel they are working with him rather than for him. While his orders are given clearly and forcefully and while he maintains, at all times, strict discipline, all his acts are tempered with reason and understanding. The true executive is a leader, not a tyrant; he gives credit where credit is due and knows that a smile and a word of encouragement spur his men on to renewed efforts, whereas a frown and a few ill-chosen words of blame frequently turn an otherwise efficient worker into a discouraged, disheartened mortal who labors with but one thought, that of escape when the closing time whistle blows.

Leadership.—No executive can be truly successful unless he makes of himself the acknowledged leader of his men. Leadership implies faith on the part of the followers. This faith can only be inspired when an executive has intelligent faith in himself and in his ability to accomplish that which he has set out to do. He can then inspire his men with his own indomitable spirit to carry on until the task set is accomplished. This quality of leadership must be inherent, but it cannot be allowed to lie dormant nor run rampant. How frequently we find a man gifted with exceptional qualities of leadership which he is employing in a dishonest or unworthy cause, whereas his talents would open to him untold possibilities if used in the right direction. Or again we find a man of inherent ability who, after a good start, has come to the stage where he allows his work

and his men to drift placidly along as he has become too self-satisfied, too mentally and physically lazy. The true executive is a leader always. He utilizes and develops his powers and so guides and controls his men that he calls to life latent powers within them and has them accomplish things they never dreamed were within their power. Thus he develops his men and broadens their line of vision. The true executive is a maker of men. That is his life work and through that life work he enriches the lives of his workers, as well as builds and develops his industry.

Good Judgment and Teamwork.—The executive must be a believer in teamwork and continually practice it, at all times conscientiously working with his fellow executives to promote and carry out the policies of the company. These policies must be definite, yet elastic. The true executive is guided by policies, not ruled by them. He knows that policies to be effective must be flexible to meet varying conditions and that there is no one rule that will suit every case. The ability to use good judgment is a test of the fitness of the executive to hold his position. Good judgment is synonymous with common sense. Frederick W. Taylor gave common sense, character and integrity as three essentials for success, each being to his mind even more important than education itself. Taylor defined common sense as "the ability to decide as to the relative importance of things —the ability to select from among the several possible lines of action which lie before you the one act which is best, the one which will yield the largest return. . . . Character is the ability to do these things which your common sense tells you you ought to do; the ability above all to do things which are disagreeable, which you do not like. It takes but little character to do difficult things if you like them. It takes a lot of character to do things which are tiresome, monotonous and unpleasant."

Self-Control.—Self-control is a prerequisite to success in business. To be an executive—a manager of men—one must first manage himself. The calm executive inspires like conduct in others. Calmness as well as emotion is contagious. A mild but firm executive is reliable. He can be depended upon to face all issues openly and fairly. This reassures the employees and promotes good feeling and cooperation.

Integrity.—Integrity in business is more than keeping within the law. Again to quote Taylor, integrity is "that straightforward honesty of purpose which makes a man truthful, not only to others but with himself; which makes a man high-minded, gives him high aspirations and high ideals."

Fitness for the Work.—When an executive is in a state of continual irritation and is unreasonable toward those who work for him, it is usually due to the fact that he is not suited to the work that he is doing. This does not mean that he would not prove an able and successful executive in another line of work, or that he cannot develop in his present line, provided he calmly faces the facts and acknowledges to himself his own shortcomings. An executive who remains in such a position and makes no effort to mold himself to his work is not fair to his men, to the concern for which he works, or to himself. He should, if possible, seek a position in which the work will be more suited to his abilities and inclinations.

The trouble lies in the fact that a man frequently accepts an executive position ignorant of conditions and what his future relationships will be. He is apt to consider salary above all else. The consequence is that he finds himself working under conditions far different from those which he had expected,—he loses heart, becomes discouraged and unreasonable and in such a state of mind where he sees conditions in a distorted light. Such an executive should either change his position, seeking one which gives him the opportunities he desires, or else look at conditions squarely, analyze his own deficiencies and seek to overcome them, and at the same time concentrate on getting the utmost out of the position he then holds. If, through force of circumstances, a man must remain in a position the work of which does not interest him, then he should conscientiously strive to develop an interest in it. This is by no means an easy course to pursue, but once a person seeks to know all he can about a subject it is most unusual not to find an interest growing.

One of our well-known manufacturers among the younger group desired above all things to be an artist. At least he thought he did. His father gave him every opportunity to prove his ability. Finding, however, that his talents, along that line, were only of a mediocre grade, the father bought for his son a financial interest in a textile

mill on the condition that he would devote a certain portion of his time to the work of the mill. While at first the work lacked interest and the noise and confusion of the mill, if anything, were repulsive to him, he was conscientious in carrying out the agreement made with his father. Next he found an interest in the dyeing of the cloth and in the beauty of the finished product. From that his interest grew until it took in every part of the manufacturing process and he now is so absorbed in his work that it is a source of wonder to his family and friends. This only tends to show that our interests depend primarily upon knowledge and that an interest can be developed in practically any line of business, provided sufficient knowledge is acquired in that particular subject. The mere act of acquiring knowledge itself arouses interest.

Scientific Trend of Mind.—Last, but far from being least in importance, the executive must have a trained mind. He must be a seeker of facts—one who analyzes his problems rather than jumps at conclusions. The successful executive is not the snap-judgment executive who prides himself on an immediate answer to every question. In the average case all the so-called ability of such an executive is superficial. His decisions are based upon merely the facts that appear on the surface, many of them misleading. He may be successful for a while due to lucky guesses or to the fact that someone with good common sense and reasoning power is guiding him, but his success can hardly be permanent.

Such a record will be like that of the sales manager of a good-sized concern manufacturing greases and oils. After he came with the company the sales increased in a most satisfactory manner. The sales manager took all credit upon himself, although credit was largely due to the efforts of a hard-working sales engineer that had come with the company at about the same time. A considerable part of the increased sales were due to orders that had come from a large steel mill. The orders had been placed due to the fact that the sales engineer had helped the steel mill out of a rather serious difficulty by solving several of their lubricating problems. The sales manager, instead of appreciating his subordinate's efforts, felt he could obtain still larger orders by calling upon the steel people himself. He did and was received by the steam engineer, a very capable but intensely practical man—one who wanted facts and had no

patience or time for anything but facts. The sales manager, aware of the circumstances under which the subordinate won the goodwill of the steam engineer and subsequent orders, thought he would do likewise. So, happening to know where some very good coal could be bought, he asked the engineer what kind of coal they were using. The engineer answered good coal averaging around 14,000 B.T.U. Immediately the sales manager said he could tell them where to get coal of 23,000 B.T.U., answering as usual without any basis of facts.[1] The steam engineer terminated the interview without giving an order and later sent a memorandum to the general manager of the oil company asking that in the future they would kindly send a representative who knew what he was talking about.

Successful Executives Use Facts.—The successful executive is he who knows where to seek facts, organizes them, grasps the essentials and by the use of good common sense, concentration of attention to the matter on hand, and reasoning, deducts the logical conclusions and so solves his problem. This same marshalling of facts, careful analysis and clear thinking applies to the solution of all problems, whether it be one of technique involving the coordination of the work of men, materials and machines or a question of a complaint on the part of a worker. In all cases the facts must be known and no decision rendered until there has been sufficient time to weigh and consider them. The handling of a complaint may seem a trivial matter, but when it is realized how the news spreads among the other workers and what effect an unwise, hasty decision may have on the morale of the working force, it is realized that even a seemingly unimportant decision should not be made in undue haste.

To the casual observer a thoroughly competent executive may frequently make what seems to the on-looker to be a snap-judgment answer—an answer without time for serious consideration. The truth in such a case is that the executive has cultivated habits of mental alertness and proper thinking. He has so trained his mind by analyzing every problem that his brain functions almost automatically, analyzing thé proposition, finding the heart of the matter and deducting the logical conclusion. What seems to be, in this case,

[1] A fair range of the thermal power of steam coal is from 13,500 to 15,000 B.T.U. per pound.

the result of intuition or genius is in reality the result of knowledge, of painstaking effort in similar instances in the past.

Summary of Executive Work.—The chief work of an executive is leadership and coordination of activities, whether it be the coordination of the work of the heads of the various departments, as is the function of the general manager, or the coordination of the work of the men within a department, as is the work of a department head. The old adage that a fleet is no swifter than its slowest battleship holds equally true in business. It is the work of the executive to guide and inspire his men, even to the slowest unit, and to develop within each and every one a spirit of cooperation, of working together efficiently for the common good of the concern. The larger the organization that the executive controls, the greater is the degree of executive ability required. Between two men, one of high technical knowledge, the other of greater executive ability but lesser technical knowledge, the choice for a large organization will invariably go to the man who has the greater managerial ability as his prime function is to manage; if need be, he can hire technical assistants. Industry is now, and always will be, in need of good executives, and there will always be a premium on their services. The men in greatest demand today are men of executive ability with the proper training in the principles of modern organization and management.

CHAPTER III

PRINCIPLES OF ORGANIZATION

Daily Work of the Sole Proprietor.—The owner in a small sole proprietorship business is a "Jack of all trades." He is president, treasurer, secretary, general manager, purchasing agent, sales manager, all in one, and frequently does much of the routine work as well. All the functions which go to make up the organization and management of a business are interwoven in the daily work of the "boss." He must assume many different positions every day. He must have the practical knowledge to operate efficiently each activity of the business. He must understand modern management methods and have the ability to use common sense in applying that knowledge in every phase of his business.

The average sole proprietor does not think of his work in that way. To him it is just "the business." He does not realize that he performs many distinct functions and that a good working knowledge of the operation of each of those functions would help him in his everyday work. Purchasing, for example, to him is giving an order to a salesman, only too frequently without sufficient knowledge of other sources of supply. Purchasing is something that must be done, so he gets it over as quickly as he can so as not to "keep him back from his work." He drives as hard a bargain as he can, frequently patting himself on the back on account of getting a big discount from list price, little realizing that list price was set so high that he could very easily be given a gratifyingly big discount and still have the price high enough to assure a substantial profit to the concern from which he was buying.

As an instance, a certain man through hard and persistent effort had built up quite a nice little business. The constant complaint of this old gentleman was that his two sons had a lot of "newfangled" ideas about business and that if they would only lose some of these foolish notions he could retire and turn the business over to them. As it was, he said, he must keep on working every day, for his sons would surely ruin his business for him if he allowed

them to handle it. Suddenly he became very ill and had to undergo a serious operation. His ill health forced him to remain away from his business for over a year. His sons, being men of mature judgment and knowing that their so-called "new-fangled notions" were in reality good business practice, reorganized the method of doing business, giving each function the consideration which it deserved, and by the end of a year greatly increased the output and profits.

Presenting Business Principles.—In a corporation there are the same functions as in a sole proprietorship, but in a large corporation each function is under the supervision of some one person who is held responsible for the carrying out of that function. All functions are then coordinated, balanced and controlled.

As the large corporation lends itself to a clear, concise and complete presentation, a large industrial corporation will be used as a basis in the discussion following so as to bring out all principles.

Application of Principles.—After a thorough understanding and appreciation is gained of the principles of industrial organization and management, as brought out in the discussion of a large manufacturing concern, and an idea from illustrations of how these principles work out in different sized concerns, their application to any business, no matter what the size or kind, will all figure down to a case of adaptation, which, after all, is the use of good common sense in applying knowledge.

Occasionally, we find one of the well-known business men expressing his view that certain business methods and practice in his concern are applicable to his business alone, and that practice which is basic in another business does not apply to his. He cannot appreciate that there are certain fundamentals common to all businesses, although their application must of necessity vary to suit individual conditions. He is one of that class that just "knows" his business is different from that of any other concern.

Such executives are like John's mother who phoned to a neighbor and asked her to please tell her son Billy to stop fighting John, as John never fought. But Billy said, "What does she call fighting? If John doesn't fight, what caused this lump on my head?"

Nearness often blinds one to true conditions. That is why an outside consultant can frequently point out glaring inefficiencies which we were too near to see. This is due to the fact that the

consultant has the broad viewpoint. He is away from the wearing, time-devouring details that confront the executive. He sees the problem from an unbiased standpoint and in the light of comparison with other similar problems in the past. His "putting his finger on the weak spot" is not any miraculous feat. He simply considers each new problem in the light of the fundamentals common to all business and sees whether they have been correctly applied in this particular instance. The old adage, "There is nothing new under the sun," holds true even in the most complicated business of today, as it, for success, must be based on the same underlying principles as the sole proprietorship spoken of at the beginning of the chapter.

Principles Underlying Any Manufacturing Business.—Any manufacturing business to be successful must be:

1. Built around certain basic principles. (a) Along definite, carefully planned lines so that the structure will be strong and will not collapse under its own growth and weight. (b) To withstand the continually changing conditions in the business world.
2. Conducted efficiently—in a humane way—economically and for the good of public service.

In other words, a manufacturing business must be well organized and efficiently managed.

What Is Organization?—Organization may be considered as the building and developing element, the structural element; and management as the directing, controlling and coordinating element. Organization means the structure or form of an enterprise and the arrangement of all parts thereof in a suitable manner for use or service. It further includes laying out the scope and functions of all parts, selecting the proper individuals to carry on the work and determining their duties, together with their relationships and contacts with one another.

Need of Sound Organization Methods.—Only too often in industrial concerns there is no real plan of organization or, at best, only a faulty one. Many concerns in the past have simply grown with the times, the organization being built about the available per-

sonnel without any reference whatsoever to any definite plan. The result invariably has been weakness in the organization structure and continual internal friction. Frequently some members of such an organization are very capable, but they have not the opportunity for fullest growth and development, or else the organization is lop-sided, that is, developed in one place and restricted in another. Ordinarily, too, there are apt to be many "doers" but few planners. Effort is from the narrow standpoint of the work in hand, rather than from a broad conception of the good of the concern as a whole. Attention is concentrated on details, while the big problems wait neglected.

Such concerns as above described may pay good dividends and apparently travel a smooth path as long as prosperous times in business prevail, but at the first signs of a lessening in general activity they immediately begin to show the effect. Ordinarily those in charge are so burdened with an infinitude of details and are so close to their job that they cannot see conditions in their true light and hence cannot realize that the underlying cause is due to lack of sound organization methods. Such concerns are marked by an absence of coordination of activities. The sales department almost invariably considers its function to consist solely of selling, with no responsibility whatsoever for cooperation with the manufacturing department. The manufacturing department, therefore, cannot plan its work according to any schedule of sales expectations, and is forced to run unevenly and inefficiently with resultant high labor turnover and high manufacturing costs. Likewise, the manufacturing department is centered solely with its own interests, and so on throughout the entire organization. Each department operates almost as a separate and distinct unit, ignoring other departments or even going so far as to consider them in the light of competitors, rather than co-workers in a common cause.

Organization Means Cooperation and Coordination.—Where the organization is built up conforming to the dictates of sound organization methods, such conditions cannot exist, as an organization is then developed whose keynote is cooperation and coordination, one which will make possible maximum results with a minimum of expense and effort.

Much of the criticism that has been leveled at the management

of certain concerns has been due to faulty organization. A few years ago an able executive resigned his position to accept the appointment of vice-president in charge of manufacturing for a large automobile concern. While the latter company had had phenomenal growth, it had grown like "Topsy" and was fast becoming top-heavy. Flaws in its organization structure were glaring to the new executive. He found everything was built around certain executives, a number of whom were far from being suited for their work, now that the company had grown to its present size. Being a splendid type of man as well as a capable executive, he began in a quiet way to reorganize, but at the same time strove to make all adjustments as smoothly and amicably as he could. Conditions improved but not as fast as the controlling stockholders, ignorant of true conditions, expected. They thought only of their profits and could not understand why they should not be as big as they had been in the past. All criticism was leveled at what they called the inefficient management of the new vice-president and under pressure he resigned. A new man was brought in to take his place. He was able, but "rough-shod." He carried out the plan or reorganization of his predecessor, but in a very different manner. He literally tore apart the old organization and built it anew along correct organization methods. While for a time it looked like total disruption of the company, his very ruthlessness in this case produced the desired results. Fortunately for the concern, however, at this point he was called to reorganize another concern in similar condition.

The choice of the vice-president to be his successor was likewise a most fortunate one. In a quiet, dignified manner he took over the reins of control, his composure and self-confidence reassured those associated with him, the feeling of unrest and upheaval gave way to calmness and a spirit of well-being and confidence in the future of the concern. The present vice-president is frequently given as an example of what an executive should be. True, he is a most able executive and deserves all the credit given him, but credit should equally be given to the splendid organization which has made possible his efficient management. Developments in management which he inaugurated and which succeeded with little difficulty would not have been possible if his concern had not been reorganized according to sound organization principles.

Underlying Principles of Organization

As each business enterprise has conditions peculiar to itself, a set of rules cannot be laid down that would be applicable to the organization of all enterprises. However, certain underlying principles can be given, among which are:

First Principle.—*A thorough study should be made of the product to be manufactured, or the merchandise or service to be sold, the market and channels of distribution, the housing, the machinery and equipment required, the labor, supervision, management and all other requirements.*

Certainly, no one of sound business judgment would attempt to build an organization without a thorough knowledge of the requirements of the business for which the organization is being provided. Industrial concerns are organized primarily with the idea of making a profit for their owners. It would therefore be decidedly foolhardy to rush into a business without first deciding whether the article to be produced is what the public wants, whether it can be produced at the time it is wanted and at a price the public is willing and able to pay.

A more thorough discussion of this first principle will be given in Chapters VI, VII and VIII. At this point, however, it might be well to bear in mind two things that are rarely given the attention they merit. First, the value to be gained from advice from reliable outside sources; second, the necessity for formulating company policies at the very inception so as to have a basis for a consistent plan of action and thus guard against future difficulties.

Common Uses of Advice.—If a business man wishes to buy stocks or bonds, he does not simply go into the market and buy stocks or bonds at random. He consults with his banker or a responsible broker so as to find out the standing of the concerns issuing the stock or bonds, to know what stocks and bonds they have issued, the earning power of the concerns in question and the efficiency of their management. Likewise, if he wishes to build a new building, he does not simply draw up a new plan. He consults with an engineering concern specializing in that line. Yet the same person will feel confident to go ahead and build up a business organization without consulting anyone. He does not feel qualified to act as an engineer, nor does he feel that he has that fund of financial knowl-

edge that the banker or the broker has; yet he is confident that he can build up an organization—for, as he terms it, he is a "business man." He little realizes that in organizing a business there is a fund of general knowledge required that is far greater in extent than that specialized knowledge needed by the engineer or the broker.

Before starting any business it is well to consult one's banker. He is a student of economic conditions, is conservative, and from his knowledge of general business and organization of similar concerns can frequently point out pitfalls to be guarded against. Likewise, it is well to give serious consideration to the advice of older business men who have had experience along the same or similar lines. Under certain circumstances it will be found advisable to secure the services of a reliable firm of consultants in industrial organization and management. It is so easy to overlook weaknesses in plans in which we are interested that it is always well to have one, or preferably two or more, unbiased persons of sound business judgment consider them carefully and give us the benefit of their advice before we adopt them.

Company Policies.—In considering the second point, that of the necessity for formulating company policies at the very inception of the business, it should be borne in mind that policies designate the aims of the business. They are the standards set for the guidance of management. Policies define the true interests of the company, the ideals to be striven for, and outline broadly the methods to be used in their accomplishment. In formulating policies care must be used that they are not so idealistic as to be a pretty sentiment on paper but nothing more. Policies must set practical ideals that are in accordance with sound business judgment. Otherwise they will be ineffective and valueless as a guide to management. They must embody the ideal, for only by reaching do we grow, but they must be "workable." High sounding policies are fine, but are worse than useless if they are not possible of being carried out.

Policies should be definite and comprehensive, yet elastic. They must give a basis for action, setting forth the goal that is to be aimed at and the means and approximate methods to be used in arriving at that end, but they must not give arbitrary rules which stifle initiative and allow no deviation to meet changed conditions.

In discussing policies no hairline distinction should be made

between types, as the so-called types are stages of development and application rather than distinct entities. Thus, the general policies in a large corporation are formulated by the owners or their representatives—the board of directors. In turn the major executives, taking into consideration actual internal working conditions and influencing external factors, put these general policies into form and use by applying them to the conduct of the specific department over which they have jurisdiction so as to formulate in a definite way the major policies for each major department.

Policies thus formulated are directly applicable to particular departments to be of use in the actual operation of those departments, and yet the policies of all departments supplement one another so as to keep all activities of the business in unison and in accordance with the general policies as laid down by the board of directors. The several department heads, in turn, still further develop and give scope to these major policies in formulating for their respective departments departmental policies which are in greater detail and which set forth the best methods and means to be used in carrying out the details of operation of their function, thus doing their part in bringing about the full consummation of the aim of the company as laid down by the board of directors.

An Example of Policy.—The policy of a large tire manufacturing concern may be to produce the finest grade of tire that can be made to sell at a given price. The heads of the sales, engineering and manufacturing departments in conference will consider how they may best utilize plant capacity and sales effort so as to carry out this company policy. After working together and deciding what is best to do, they will submit their decisions to the president and general manager for their consideration and approval. Thus a policy may be formulated to reduce costs by eliminating excess variety and standardizing upon certain sizes and types of tires. In turn the sales manager and the manager of manufacturing would formulate the necessary policies for their respective departments, so as to effectually carry out the company's policy. Likewise with the company's policy in regard to the question of labor, of purchasing, of advertising, of financing, and so on.

For the sake of clearness and to show the extent of the policies needed in a business, policies might be broadly classified as general

company policies, major policies and departmental policies, always bearing in mind, however, that they are not three distinct classes but rather stages and developments of the same underlying idea.

Results of Lack of Policies.—Coming back to the first principle and the need of formulating company policies at the very inception of the business, perhaps the best illustration of the result of the lack of such guiding policies was evidenced in the period of business depression in 1920 when so many companies were in serious financial difficulties due to their unwarranted expansion in the preceding boom years. A policy of expanding only when the cost of such expansion can be taken care of out of profits and of gradual rather than of spasmodic increase of plant capacity, would have prevented such difficulties and, in many cases, failure due to the contraction of enormous debts to build plants totally unwarranted. A policy that may be considered by many to be unduly conservative but one which, in the long run, is apt to prove highly advisable for the average concern, is that of making regular provision for expansion out of profits and of making the actual expansion during periods of relative inactivity in business rather than boom times. By so doing savings are made in the costs of expansion, the plant capacity is kept in proportion to normal and not unduly stimulated demand, and the company does its part in stabilizing general business. By this is not meant that if a new machine is required its purchase must be deferred until periods of dullness in business, or that necessary additional salesmen must not be taken on when business warrants.

Policies, as already stated, are not iron-clad rules which allow no deviation to meet changed conditions, but they are the guides which keep the company moving along the channel it was created to follow, and not swept down side branches by every new whim or transitory development in business. Herbert Hoover, perhaps one of the most outstanding figures and best influences in modern business, in the following quotation shows the need of some such policy in the great majority of business concerns. "Our studies of industries as a whole show that we usually expand our equipment at the periods of maximum demand for their products instead of doing our plant extension during periods of slack consumption. We thus make double demands on labor and we doubly increase unemployment in periods of reduced consumption."

Second Principle.—*The organization should be built around the main functions of the business and not around an individual or group of individuals.*

The nature of a business determines the main functions of that business and thus of itself lays down the proper basis for organization. Functions can grow indefinitely—persons are restricted. The fallacy of building an organization around an individual, no matter how competent he may be, has been demonstrated in numerous instances in the past where, when the principal executive has become incapacitated, the concern has immediately become as a ship without a rudder. If the organization of such concerns had been built around functions, there would have been a proper distribution of work and no one man could have become so all-powerful and so depended upon as to be indispensable. While the loss of a strong man would have been felt it would not have seriously interfered with the permanency of the concern.

No individual can last forever, nor is anyone infallible. Even the most capable executive sometimes makes mistakes. In fact, records of Dun and Bradstreet show that the vast majority of business failures are due to personal faults, mainly incompetence and inexperience. Where an organization is built around an individual, that organization is almost certain to be out of balance due to over-emphasis of those departments in the work of which the predominating executive has most personal interest. Such a business has no guaranty of permanency.

Failure Due to Unbalanced Functions.—A striking example of the ineffectiveness of an organization built around an individual is that of a concern that was incorporated to manufacture certain fabrics after a new method of treatment discovered by a well-known research chemist. The entire organization was built around the research man, with the result that after a struggle of several years the company was a failure. The reason plainly was that certain functions were emphasized at the expense of others. Being interested in research chemistry the laboratory was given every consideration, while very little thought or attention was given to the sales department, orders being expected to come in of themselves without comparatively any advertising or sales promotion work having been done. Likewise, the manufacturing department was expected to be

prepared to stop using regular production methods at a moment's notice and in their place substitute any new treatment the research department wished to try out under actual manufacturing conditions. Such a state of affairs could not have existed if the organization had been built around the necessary functions, as each function would have received the attention it merited and the result would have been a balanced concern ready to do the work for which it was incorporated.

Applying the Second Principle.—As a first step, each function—in other words, each activity—required to carry on the business should be recognized and segregated. Like or complementary functions should then be grouped together so as to form several major groups. Each of these main groups will then be the basis for a major department. This gives a framework for a well-balanced, clear-cut organization and does away with any tendency toward loose haphazard organization with the resultant overlapping and duplication of effort and concentration on one or more functions to the detriment or omission of others. The organization built around functions is strong and has logical channels for growth and development along each of the major fields of activity. Flexibility is provided for as adjustments necessary to meet changing conditions in any field of business activity can be made within the respective department in charge of that activity without disturbing the organization or work of other departments or the general plan of the organization as a whole.

Third Principle.—*The departments, divisions and subdivisions of the enterprise and their functions should be clearly defined. The details of each department and its divisions should be logically and carefully coordinated so that each step of the work can be carried out to the best advantage in the shortest possible time.*

With the major departments set up to take care of the respective groups of like and complementary functions and with a proper set-up of divisions and subdivisions within each department, adequate care of each activity of the business is assured. This is in contrast to those organizations in which there is no scientific distribution of work, where a person who has considerable capacity for work or one who has sufficient time is given additional work to do regardless

of whether it is of similar or related nature to his other work. We all are familiar with concerns where certain good-natured, conscientious workers are continually given work outside of their regular line of duties merely because they are willing and have a capacity for work. Fellow workers in such concerns easily get into the habit of "Let George do it." There is in consequence a lack of responsibility, a lowering of morale, and the work as a whole is bound to suffer.

When there is an overflow of work in those concerns where there is no definite assignment of functions to specific departments, then almost invariably new departments to care for the additional work are set up with no reference to any logical plan of relation of functions and clear-cut division of work. Departmental jealousy and friction are inevitably the result. In one large industrial concern there were found three separate and unrelated departments each duplicating a part of the work of the other two, each working at cross-purposes with one another and doing their utmost to court managerial favor at the expense of the other departments. After a thorough reorganization with functions logically placed, unnecessary departments done away with and the functions and scope of each remaining department and division clearly defined, internal friction was ironed out, a spirit of cooperation developed, a closer coordination of the various departments was made possible and costs materially reduced.

It is only by clearly defining the function and scope of each department, division and subdivision that responsibility can be fixed, true department costs known, department budgets correctly drawn up and the required man power accurately determined.

Fourth Principle.—*There should be centralized executive control.*

Centralized executive control is absolutely necessary in order to have authority and responsibility definitely fixed. This does not mean that an executive should attempt to do everything himself. He should, in turn, delegate certain authority and responsibility to his subordinates. Functionalization, departmentalization and centralized executive authority and responsibility establish a definite basis of control.

Given the required authority and the responsibility for the oper-

ation of his company, his department, his division, his section or gang, as the case may be, puts things squarely up to the man in charge. Success or failure in his position is then up to him. This develops the individual, while constant detailed supervision and lack of responsibility stifles initiative and discourages and prevents growth. A man does his best work when put on his mettle and held strictly accountable for results.

The principle of centralized executive control with delegation of authority and responsibility requires the establishment of definite lines of supervision and a tapering of authority from the chief executive down to the junior executives and the foremen in direct charge of the workers. This gives a definite basis for discipline and coordination of effort, acts as an incentive for growth as it points out the possible lines of advancement, and makes provision for understudies for each executive. This latter is an important item as otherwise there would be no logical man for advancement to fill an executive's position should he become incapacitated or resign for any reason.

Fifth Principle.—*The personnel should be carefully selected.*

At the head should be a constructive, conservative, broadminded person with a well-balanced training and the quality of leadership. Each subordinate should be selected on account of his particular training and personality and so placed that his abilities will be most fully taken advantage of. This insures the strongest and most effective organization with the available personnel.

The ideal plan in selecting the personnel for a concern would be to analyze the requirements of each given position and then find a man for that position whose qualifications measure up to the requirements. With the segregation of functions the ability required to fill a position can be accurately determined, but it is quite a different matter to find a man with just the right qualifications for each position, especially if there is only a certain given group of men from among whom selection can be made. For this reason it is frequently easier to build up an organization for a new concern than to reorganize an established business. In the latter case old habits must be broken, a difficult task; inertia must be overcome and enthusiasm for the new order of things inspired. The old saying, "It is difficult to get a shoemaker to change his last," is

found to be very true in such cases. One solution in such an instance is to take someone who is capable and willing to cooperate and place him in a position where he will have an influence over the others and get them thinking along the right channels. "As a man thinketh so he is."

Summary.—The building of an effective organization requires the use of sound business judgment. No one plan can be applied indiscriminately to every business. Each organization is a distinct problem in itself and one to which should be brought to bear all available knowledge and experience in that particular line of business for which an organization is being provided. First should come a thorough analysis of the entire proposition—of the product to be manufactured or the service to be sold, the markets and channels of distribution, the housing, machinery and equipment, the labor, supervision, management and all other requirements. The results of such an analysis will give a very fair approximation of the ultimate chances of success and of the breadth of the problem involved, and will further act as an initial basis for the future operation of the business. Next will come the determination of the necessary functions, stressing those functions which are the most important and which will require the most attention in that particular business, logically grouping like and complementary functions and setting up the major departments to care for the respective groups. With the scope and duties of each department clearly defined and with a proper set-up of divisions and subdivisions within each department, the final step will be to pick the men best fitted for the work to head each department and subdivision, giving them sufficient authority to operate without interference, and then holding them strictly accountable for results. Such a system of organization lays a good workable basis for management, and is conducive of growth and permanency.

In applying the above principles in a going concern, one must keep constantly in mind the fact that in every concern there exist conditions which stand in the way of the achievement of an ideal organization. Company politics, the available personnel, inertia, the force of tradition and the views and weight of the opinion of influential executives, all must be considered and provision made for them.

CHAPTER IV

TYPES OF ORGANIZATION

Basic Considerations of Organization.—As the aim of any business is to make a profit for its owners, production implies more than the mere making of a given product. It implies the making of that product at the lowest cost consistent with the quality of goods produced. Likewise, selling consists of more than the mere distribution of goods produced. Goods must be sold under such terms as will be satisfactory to both the buyer and the producer as well. To insure such results a concern must be properly organized so as to permit of coordination of those distinct and totally unlike functions—financing, engineering, purchasing, production and selling, and to foster cooperation between all factions. Proper organization is the basis for teamwork, that sincere cooperation by which each individual works at his best efficiency, working, however, not as an independent unit but as a necessary part of a group total. Practically everyone after a little thought can point out an instance where a poorly constructed and equipped plant achieved better results than a competitor with an up-to-date plant. On analysis it would invariably be found that in each instance the poor plant had a good organization while in the up-to-date plant there was something radically wrong with its plan of organization.

Good organization is not confined to any particular type any more than good management is restricted to any one type of manager or any one system. A study of the organization of a number of successful industrial concerns, however, will show that they all rest upon certain well-recognized, clearly defined principles and all follow or are adaptations of certain basic types. This does not mean that a plan of organization, successful in one concern, can be taken bodily and be expected to fit the needs of another concern. The organization of each concern is a distinct problem in itself. By considering the underlying principles of organization and the types of organization, a structure can be built up and molded to suit the particular

needs of the individual concern. A well-constructed organization is characterized by a smooth flow of work and a definiteness of control with apparently very little guidance on the part of the management.

Types of Organization

There are several distinct types of organization which have been developed during the growth of business of which the most common are: (1) line, (2) functional, and (3) line and staff.

1. **Line Type of Organization.**—The "line" type, sometimes called the "military" organization, is patterned after the ancient form

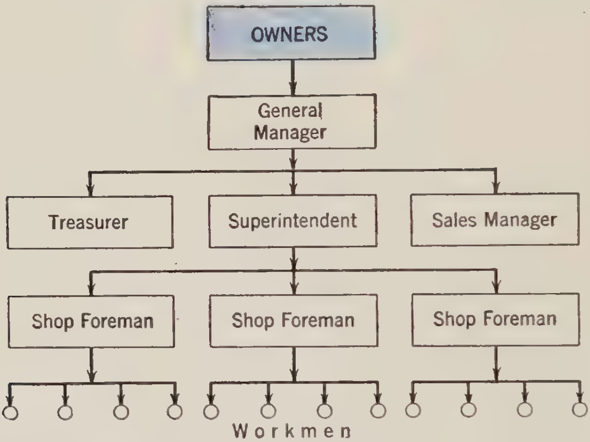


Figure 1. Chart Illustrating Line Type of Organization

of military control, under which the general made all decisions, mapped out all plans and procedures and issued all orders to his subordinates who were directly responsible for carrying them out. The subordinates, in turn, would pass the orders on to those directly under them, and so on down the line to the ranks, the orders being transmitted through colonels, majors, captains, lieutenants and non-commissioned officers to the common soldiers. In an industrial plant the orders are transmitted in the same way, from the manager through superintendents, foremen of the shops, assistant foremen and gang bosses to the workers. In business the line organization is the direct outgrowth of the one-man organization in which the owner or manager issued all orders to the workers and the workers were directly

responsible to him. As the business grew and the owner or manager found it impossible to attend to everything and control everything, he hired an assistant who was directly responsible to him and through whom he issued his orders to the workers. As the business further developed, more and more assistants were required, each one in the organization being responsible only to the one immediately above him. Figure 1 illustrates the line type of organization.

Advantages and Disadvantages of the "Line" Type.—The line type of organization is most excellent in so far as the giving of orders and the defining of duties and responsibilities are concerned. Discipline is easily maintained and control is definite. There are, however, very marked disadvantages. To be efficient, the line organization necessitates the highest possible grade of executives and workers.

As it is humanly impossible for any man to be efficient in every line of endeavor, therein lies the main weakness of the line type. No other type demands such all-round knowledge and ability. The foreman of a shop has complete charge of that shop and is held directly responsible. He must understand how the work should be done, plan and lay out the work for the whole shop, see that the equipment for doing the work is on hand and in good condition, determine the proper methods, hire the workers, instruct them, see that they work steadily, accurately and rapidly, adjust their wages and take care of an infinite number of other details. He in his turn demands of those under him more than can be expected of them. He becomes a driver instead of a leader. Line organization is an autocratic control requiring absolute obedience and complete knowledge, with the result that, while much may be accomplished, the work is apt to be crude and the workmen "Jack of all trades but master of none."

Summing up, the *disadvantages* are:

1. It is most difficult to get the all-round capable executives and workers required. Only men of unusual natural ability, wide knowledge and years of special training could possibly attain any marked degree of success in their position under the line type. Such men are few, and those there are are content to hold only the highest positions.

2. Specialization is not made use of, each in the organization having a variety of duties. Methods, therefore, are apt to be inefficient, much time is lost passing from one job to another and costs are high. In the shop skilled machinists paid high wages are often found doing the work that a laborer with a little training could readily do, while the foreman is frequently found doing the work that should be done by a clerk.

3. Executives are overloaded with duties and responsibilities and, therefore, cannot work to the best of their ability. Having to care for so many details they have no time left for their true functions of managing.

4. Too much reliance is likely to be placed upon the chief or other important executives, with resultant disaster if they have to be replaced.

5. There is a lack of full coordination of effort and cooperation. In the shops each foreman acts independently of the others and is responsible only to the superintendent. There is lacking that feeling of working together, of being a part of the team.

6. Line organization is not flexible, therefore cannot be readily adjusted to meet changed conditions.

Place of the Line Type in Industry.—It must not be concluded, however, that the line type of organization does not hold an important place in modern business. While the strict line organization is rarely found in any enterprise of considerable size, line organization is invariably found as a part of the organization of every enterprise.

2. Functional Type of Organization.—The functional type of organization is radically different from line organization. It does away with the demand for "all-round" men and in their place uses experts, men trained for a particular kind of work. The strict functional type of organization applies the principle of division of labor, both mental and manual, to its fullest degree and from it derives the advantages of increased dexterity on the part of each individual in the organization and of accurate knowledge of man-power requirements. This latter permits of planning for future activities from a basis of facts rather than guesses or approximations.

The direct flow of authority from the head of the organization down to the workers is done away with. The work is divided according to the functions needed. A specialist is then placed in charge of each function or small group of related functions. Each specialist or supervisor has control over the functions in his charge, no matter where those functions are found throughout the business. Thus there would be a specialist in charge of all purchasing, another in charge of maintenance, still another in charge of hiring all employees, and so forth.

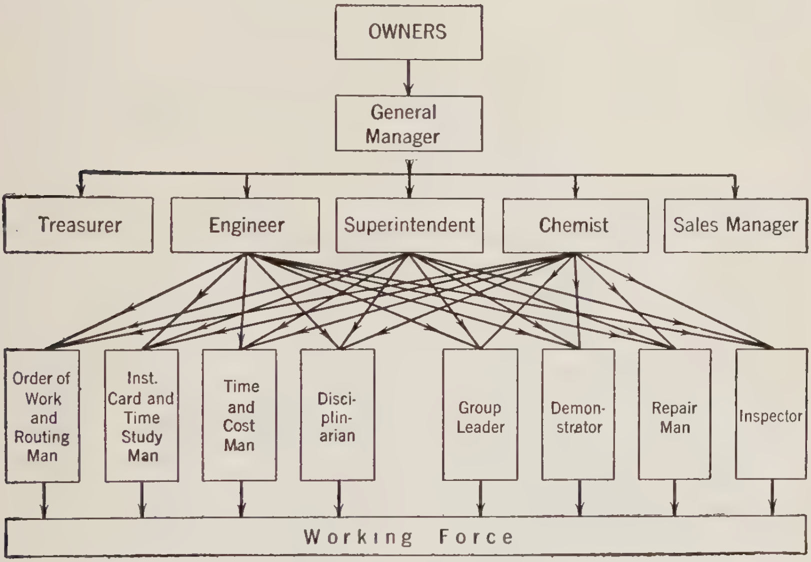


Figure 2. Chart Illustrating Functional Type of Organization

Under the line type the worker comes in contact with one supervisor who has absolute control in all matters relating to the workman and his work. Under functional organization the worker comes in contact and takes orders from several functional foremen or supervisors. He takes orders from and is responsible to each supervisor only in regard to the performance of the particular function or functions over which the supervisor has control.

Competent supervisors are more readily found in the functional type of organization than in the line type. The field of the supervisor being restricted to the performance of his particular functions,

he can be more readily trained for his work. Figure 2 illustrates the functional type of organization.

COMPARISON OF LINE AND FUNCTIONAL TYPES

FEATURES	LINE	FUNCTIONAL
Discipline	Easily maintained.	Weak.
Control	Definite.	Difficult to coordinate many separate functions.
Specialized Knowledge	Not utilized.	Maximum use.
Methods	If inefficient apt to continue so.	Efficient.
Workers and Executives	Demand for men of all-round ability, therefore apt to be "Jack of all trades and master of none."	Individuals highly efficient in their particular field but apt to overspecialize.

The Taylor Functional Plan.—The late Frederick W. Taylor, who contributed more to the cause of industrial management than any other one man, after many years of intimate contact with the organization of a large variety of industrial concerns covering a wide range of product, advocated the abandoning of the military type of organization and the substitution of the functional type. Taylor, whose work was in the field of shop management, described management under the functional type as consisting "in so dividing the work of management that each man from the assistant superintendent down shall have as few functions as possible to perform. If practicable the work of each man in the management should be confined to the performance of a single leading function."

The work of Taylor so revolutionized industrial thought that every student of industrial management should be familiar with his works. The following quotation is from Taylor's description of the functional type he so strongly and ably advocated.

Certainly the most marked outward characteristic of functional management lies in the fact that each workman, instead of coming in direct contact with the management at one point only, namely, through his gang boss, receives his daily orders and help directly from eight different bosses, each of whom performs his own particular function. Four of these bosses are in the planning room and of these three send their orders to

and receive their returns from the men, usually in writing. Four others are in the shop and personally help the men in their work, each boss helping in his own particular line or function only. Some of these bosses come in contact with each man only once or twice a day and then for a few minutes perhaps, while others are with the men all the time, and help each man frequently. The functions of one or two of these bosses require them to come in contact with each workman for so short a time each day that they can perform their particular duties perhaps for all of the men in the shop, and in their line they manage the entire shop. Other bosses are called upon to help their men so much and so often that each boss can perform his function for but a few men, and in this particular line a number of bosses are required, all performing the same function but each having his particular group of men to help. Thus the grouping of the men in the shop is entirely changed, each workman belonging to eight different groups according to the particular functional boss whom he happens to be working under at the moment.

Duties of Functional Shop Bosses

The following is a brief description of the duties of the four types of executive functional bosses which the writer has found it profitable to use in the active work of the shop: (1) gang bosses, (2) speed bosses, (3) inspectors, and (4) repair bosses.

The Gang Boss.—The gang boss has charge of the preparation of all work up to the time that the piece is set in the machine. It is his duty to see that every man under him has at all times at least one piece of work ahead at his machine, with all the jigs, templates, drawings, driving mechanism, sling chains, etc., ready to go into his machine as soon as the piece he is actually working on is done. The gang boss must show his men how to set their work in their machines in the quickest time, and see that they do it. He is responsible for the work being accurately and quickly set, and should be not only able but willing to pitch in himself and show the men how to set the work in record time.

Speed Boss.—The speed boss must see that the proper cutting tools are used for each piece of work, that the work is properly driven, that the cuts are started in the right part of the piece, and that the best speeds and feeds and depth of cut are used. His work begins only after the piece is in the lathe or planer, and ends when the actual machining ends. The speed boss must not only advise his men how best to do this work, but he must see that they do it in the quickest time, and that they use the speeds and feeds and depth of cut as directed on the instruction card.

In many cases he is called upon to demonstrate that the work can be done in the specified time by doing it himself in the presence of his men.

Inspector.—The inspector is responsible for the quality of the work, and both the workmen and speed bosses must see that the work is all finished to suit him. This man can, of course, do his work best if he is a master of the art of finishing work both well and quickly.

Repair Boss.—The repair boss sees that each workman keeps his machine clean, free from rust and scratches, and that he oils and treats it properly, and that all of the standards established for the care and maintenance of the machines and their accessories are rigidly maintained, such as care of belts and shifters, cleanliness of floor around machines, and orderly piling and disposition of work.

Duties of Functional Planning Bosses

The following is an outline of the duties of the four functional bosses who are located in the planning room, and who in their various functions represent the department in its connection with the men. The first three of these send their directions to and receive their returns from the men, mainly in writing. These four representatives of the planning department are, the (1) order of work and route clerk, (2) instruction card clerk, (3) time and cost clerk, and (4) shop disciplinarian.

Order of the Work and Route Clerk.—After the route clerk in the planning department has laid out the exact route which each piece of work is to travel through the shop from machine to machine in order that it may be finished at the time it is needed for assembling, and the work done in the most economical way, the order of work clerk daily writes lists instructing the workmen and also all of the executive shop bosses as to the exact order in which the work is to be done by each class of machines or men, and these lists constitute the chief means for directing the workmen in this particular function.

Instruction Card Clerks.—The "instruction card," as its name indicates, is the chief means employed by the planning department for instructing both the executive bosses and the men in all of the details of their work. It tells them briefly the general and detail drawing to refer to, the piece number and the cost order number to charge the work to, the special jigs, fixtures, or tools to use, where to start each cut, the exact depth of each cut, and how many cuts to take, the speed and feed to be used for each cut, and the time within which each operation must be finished. It also informs them as to the piece rate, the differential rate, or the premium to be paid for completing the task within the specified time

(according to the system employed) ; and further, when necessary, refers them by name to the man who will give them especial directions. This instruction card is filled in by one or more members of the planning department, according to the nature and complication of the instructions, and bears the same relation to the planning room that the drawing does to the drafting room. The man who sends it into the shop and who, in case difficulties are met with in carrying out the instructions, sees that the proper man sweeps these difficulties away, is called the instruction card foreman.

Time and Cost Clerk.—This man sends to the men through the "time ticket" all the information they need for recording their time and the cost of the work, and secures proper returns from them. He refers these for entry to the cost and time record clerks in the planning room.

Shop Disciplinarian.—In case of insubordination or impudence, repeated failure to do their duty, lateness or unexcused absence, the shop disciplinarian takes the workman or bosses in hand and applies the proper remedy. He sees that a complete record of each man's virtues and defects is kept. This man should also have much to do with readjusting the wages of the workmen. At the very least, he should invariably be consulted before any change is made. One of his important functions should be that of peace-maker.

Advantage of Functional Foremanship

Thus, under functional foremanship, the work which, under the military type of organization, was done by the single gang boss, is subdivided among eight men: (1) route clerks; (2) instruction card clerks; (3) cost and time clerks, who plan and give directions from the planning room; (4) gang bosses; (5) speed bosses; (6) inspectors; (7) repair bosses, who show the men how to carry out their instructions, and see that the work is done at the proper speed; and (8) the shop disciplinarian, who performs this function for the entire establishment.

The greatest good resulting from this change is that it becomes possible in a comparatively short time to train bosses who can really and fully perform the functions demanded of them, while under the old system it took years to train men who were after all able to perform thoroughly only a portion of their duties.[1]

It would be impossible in the space available to give due praise to the late F. W. Taylor for his great contributions to the manage-

[1] Frederick W. Taylor, Shop Management (Harper and Brothers, New York), pp. 99-104.

ment of industry. Mr. Taylor should be remembered not only for his functional plan of organization but, above all, for his philosophy of management and his efforts in behalf of scientific management. As Dexter S. Kimball brings out, the greatest and most important effect of the work of Taylor and his followers is that it has made men think as never before concerning all phases of industry.

3. **Line and Staff Type of Organization.**—The line and staff type of organization is a combination of the best features of both the line and the functional types. Authority flows from the top to the bottom as in the line type, thereby definitely fixing duties and responsibilities and insuring proper discipline. In addition to the regular line supervisors, however, there is a staff of experts. Each expert is at the head of a staff division which has charge of a single leading function or certain similar or complementary functions. The experts and their assistants work out the problems relative to the performance of the particular functions over which they have charge, no matter where those functions are found throughout the business.

Unlike under the functional type of organization, experts do not give their orders direct to the workers concerned. Their recommendations and directions are carried out through the line supervisors in charge of the workers. Thus, the line supervisor directly controls the workers under him and maintains the proper discipline. He does not, however, have to bear the heavy load of duties and responsibilities as under the line type. He is responsible for seeing that the recommendations and instructions of the staff experts are carried out, for the control of his men and for all other duties assigned to him, but he is relieved of solving the many problems covered by the staff or service divisions. Thus, the production engineering division, a staff division, would relieve the line supervisor of much planning as they would plan the flow of work through the shop and see that the proper tools and materials in the proper quantity were at the assigned machines and workplaces on schedule time. Figure 57 (page 276), showing the organization chart of the manufacturing department, illustrates what is meant by line and staff organization. The operating division is a line division, the production engineering, inspection, power and maintenance, and industrial relations divisions are service or staff divisions.

Committee Idea in Organization.—By the committee idea in organization is meant the appointment of one or more committees; that is, a group or groups of individuals, each group to consider the methods, policies or problems relating to that branch of the business in which they are most interested due to their everyday work. The work of the committee is purely advisory. Their recommendations, however, generally receive favorable action by those in authority and thus become binding.

Committees in organizations serve many purposes, one of the most vital being the fostering of the spirit of cooperation. It is not always sufficient that a concern have competent executives and good workers. The cooperation of executives and workers is most essential. Committees, if they are judiciously formed and guided, will do much toward the smooth running of a concern. The members will develop a spirit of loyalty and cooperation which will be contagious to their fellow workers. They get to know and appreciate one another's problems. From their discussion of policies and methods, they get to feel that the policies and methods are, at least in part, their own, and they are, therefore, more anxious to see that these are properly interpreted and carried out.

For the members of the committee themselves, there is the advantage of self-development through thinking out the many problems and through discussion with their associates.

Suggestions Regarding Committees.—For committees to be of greatest use their formation should be carefully thought out before any action is taken. No definite rules can be given as to the number or make-up of committees as these would depend upon the problems to be solved. The following are a few suggestions as to some of the points to be considered:

1. Size. Committees should have a sufficient number of members to provide thorough discussion, but they should not be so large as to be unwieldy. In the average case three to seven members will be found to work to best advantage, the exact number depending upon the individual case.

2. Selection of members. Members should be chosen from among those in the organization who are directly affected and most interested in the branch of the business to be considered by the particular committee. Special care should be exercised in choosing

the chairman for in his hands lies the success or failure of the committee. It is the duty of the chairman to guide tactfully the members of his committee, to smooth over diplomatically any friction between them, to keep their interest alive and to see that the work set for the committee is accomplished within the time designated.

3. Frequency and duration of conferences. Conferences should be held at intervals frequent enough to get results of practical value. Only too frequently it happens that committee meetings are so far apart that action must be taken by those in authority without waiting for the recommendations of the committee. Care also must be exercised that the conferences are not held too often and that they are not of long duration, consuming too much of the time of the members. Very often the work of committees is so slow that the result is mere talk without definite decisions.

4. Advanced notices to committee members of work to be considered. This facilitates the work of the committee as the members have had time to study carefully the problems and to have suggestions for their solution ready at the time of the meeting. In many instances two or more members can get together and work out any details or phases of the problems which relate particularly to their specific field rather than to the general work of the committee. This permits the committee to confine its discussion to major points without waste of time over boresome details and petty quibbling.

CHAPTER V

MANAGEMENT

What Is Management?—The object of organization is to develop a well-rounded, properly functionalized business structure. The work of management is to direct, control the operation of and weave together the various parts of the organization so that all factors will function properly and all persons cooperate—that is, work together economically and efficiently for a common good.

Organization and Management.—Organization does not stop where management begins. Organization and management are interwoven; they go hand in hand from the very beginning of an enterprise. The true manager is not content to just "run" the business. He wants it to grow and in order to grow it is necessary to build. The manager to be successful must have organizing ability. He must see that the business grows along logical, well-planned lines. During the World War many concerns just simply "grew," like "Topsy," with the result that in the period of readjustment following there had to be made many changes. It was a common occurrence to hear of companies being reorganized.

System

In business, planned methods of procedure are called system. System is one of the most valuable mechanisms or aids of management. Experience has proved that, in any line of endeavor, if a thing is to be done efficiently it must be done systematically. System, if properly utilized, materially aids in securing the desired results in the best possible way with the least expenditure of time and effort. Broadly, some of the advantages to be gained through the proper use of system are:

1. System is the introduction of order and method wherever found. Such an advantage is at once apparent when one considers the chaos that would reign in an office if there were no system of filing, but instead all correspondence and other data were allowed

to lie around in any place that happened to be available at the time.

2. Through system everyday work becomes routine. Routine work flows along regular accustomed channels and can be handled by less experienced or unskilled workers, as the planning required for its performance has been done for them. This is an important item as the demand for men who can be depended upon to do their own planning always far exceeds the supply.

3. Those in authority, being relieved through system of the details of execution, can devote their efforts to the master work of planning, directing and controlling. Since in the average concern, comparatively speaking, probably 90% or more of the work may be classed as routine the value of the separation of planning and routine is very evident. The executive who works at breakneck speed all day and long into the night does it because he is working without thinking. He is in a treadmill and does not realize it. If he were to stop and analyze the work he would find that the great bulk of it need never come to his desk at all as it is routine work that once planned for can be safely taken care of by subordinates.

4. Aids in the control and reduction of costs. A system based upon a certain definite purpose and a comprehensive plan of action removes doubt and makes for certainty so that true costs can be known and controlled. As system promotes smooth running, it follows that of necessity it eliminates many unnecessary factors of cost.

Rules for Applying System.—In considering the above advantages to be gained through the use of system, one must be careful not to consider system as the sure "cure all" of industrial ills. It is unfortunate that in the past many managers have become so interested in system for its own sake that they have lost sight of the objective to be gained by the use of system. The result has been the development and use of complicated systems so full of "red tape" as to more than defeat their own object. The following are a few simple rules that may be used as a guide, always bearing in mind that system is a mechanism or aid of management—a means toward an end, but not the end in itself.

1. Every system in use in a particular concern should reflect a basic, general plan. If department heads are allowed to devise their own systems irrespective of the needs of other departments, and of the concern as a whole, there is inevitable duplication of

effort, waste and internal friction. In order to secure fullest cooperation and to meet the needs of all, the basic general plan should be devised through the joint efforts of the heads of all departments and under the guidance of someone of sufficient authority to be able to pass on the system as a whole before it can be put into practice. The success of any system rests upon the cooperation of those most affected by it. No system, however perfect in itself can succeed without this necessary cooperation.

2. A system must represent a definite, useful purpose. Many otherwise up-to-date concerns maintain systems that have long outgrown their usefulness, or systems for which they would be at a loss to explain their true purpose. When you find that it is difficult to express what you are doing or why you are doing it, then it is well to stop and consider whether what you are doing is necessary or whether it is just a part of that great volume of needless labor daily performed in such an astonishingly large number of concerns.

3. Every element in a system must be worth its cost. Frequently a system may help materially in producing certain desired results but at such a cost that the "cure is worse than the disease." It is a case where the company is "system perfect," but it becomes bankrupt from the cost of maintenance of its system.

4. A system must be clear, simple, easily understood and adequate to fit the need but involving the least expenditure of time and effort.

5. There should be frequent periodic consideration of existing systems so as to be sure that the foregoing rules have been carried out, and that only the minimum amount of system required to achieve the desired results is used. It is very easy to allow a system so to develop as to be a burden with a lot of unnecessary forms. A periodic examination will tend to keep system and its resulting forms down to the essentials only.

Systematic Management vs. Scientific Management.—There is a development in the management of some concerns which might be spoken of as systematic management, and which some persons confuse with scientific management. There is, however, a broad distinction between them. Under systematic management the system in itself becomes all important instead of being merely an aid to management. Under scientific management, system is used exten-

sively, but not as the paramount feature. Scientific management includes with system a broad development of the human element and other factors associated with modern management.

Scientific Attitude.—In order to get the true value out of knowledge one must be able to know what to use and how, when and where to use it. The man who jumps at conclusions is rapidly giving way before the man who attacks his problems from the scientific standpoint—who carefully analyzes each problem and deducts the logical conclusion. Each problem can be and should be attacked scientifically, whether it be standardizing typewriters or regulating the wages of workers in a factory. The scientific attitude, the attitude demanding facts, not mere guesses or off-hand opinions, is the keynote of modern management. It is this scientific attitude toward business problems that is primarily responsible for the present lowering of production costs and at the same time maintenance of high wages.

Scientific Management

The management which applies science to management, which plans before doing, which establishes standards and methods scientifically determined and with the aid of records, sees that they are carried out, is spoken of as "Scientific Management."

W. H. Leffingwell, management engineer, very ably sums up and explains the steps taken in applying scientific management in his statement "How to Manage," as follows:

1. Define your purpose.
   You must know what is to be done before you can know How.
2. Analyze your problem.
   Your master work will then break up into many detail tasks.
   Consider them all—neglect none.
3. Seek the facts.
   Study every condition governing each task, find the undesirable elements, the desirable elements to be retained. Then standardize right conditions.
4. Devise the one best method.
   Aim to conserve energy—time—space—material.
   Determine relation of details to master task.

5. Find the person best fitted.
   For each task certain personal qualities are essential. In each person certain qualities predominate. Find the person best fitted.

6. Teach the person best fitted the one best method.
   Not by driving, but by thorough, patient teaching are understanding and skill developed.

7. Plan carefully.
   Right planning of arrangements and sequence of work will enable you to accomplish tasks in logical order—accurately—quickly—economically.

8. Win cooperation.
   Cooperation means working together. It cannot be demanded. It must be won. Accept your share of responsibilities. Respect the rights and aspirations of others.

This is Scientific Management.

Practical Application of Principles of Scientific Management.—Scientific management is of inestimable value to employers, employees and to the buying public. It lessens the cost of attaining results, without injury to health or any other detriment to the workers, improves working conditions, increases the earnings of employees, and gives at a lower cost more and better articles to the public. Just how this is done will be made clearer by illustrating from actual practice the application of Leffingwell's eight steps. Note that several of the illustrations given show how the neglect of one or more of the foregoing steps resulted in failure of the undertaking in hand.

1. Define Your Purpose.—The growth of R. H. Macy & Co., Inc., from the small retail business of a one-time sea captain to the largest cash store in the world and the third largest department store in North America, is an excellent example of a clearly defined and clearly followed purpose. Macy set as his goal the making of a fair profit through the selling of good merchandise at a lower price than that of his competitors. To accomplish this end, he found it necessary to adopt two subsidiary policies: to buy for cash and to sell for cash. By paying cash the store was generally enabled to obtain lower prices than those who paid on the usual long-term basis, and by selling for cash, it was able to avoid the expenses of maintaining

a credit department, of financing the credit extended, and of writing off bad debts. Although the store has since changed hands, the present owners, the Strauses, are loyal to the purpose of the founder. The steadfastness with which the store has continually maintained its purpose to sell quality merchandise at lowest prices has made possible sales of over $75,000,000 for 1926.

Recently, the advertising managers of a number of department stores, and especially that of a leading Fifth Avenue store in New York City, employed a variety of futuristic and cubistic effects in their advertising. They attracted attention because of their very bizarre nature but it is doubtful that they succeeded in selling merchandise. For instance, a luggage advertisement appearing in a well-known magazine was composed of wedges and triangles in kaleidoscopic fashion each giving a glimpse of some phase of a trip abroad. One triangle showed a part of a steamer, another a bit of the pyramids, another a part of a steamer's name, etc. In the same issue of that magazine another company had a realistic advertisement showing a piece of luggage in actual use on an automobile trip. The first advertisement attracted attention but nothing more; the second created desire for the goods advertised. The first artist seemed to have lost sight of the real purpose of advertising to create interest in the message and to arouse desire for the goods. To do this, attention must be secured but never at the expense of the message. The vogue for futuristic advertising seems to reflect the lack of a clear-cut purpose in advertising, a feeling that advertising is a trick to gain attention rather than a medium for creating a demand for merchandise.

One well-known accounting firm goes so far as to have its accountants, when they are given a task, outline the purpose of the task in writing and show it to the auditor from whom they received the piece of the work before they proceed with it. The company feels that this method results in the saving of a great deal of time formerly lost due to employees not having clearly in mind the purpose of their work and, therefore, many times doing unnecessary work or work that was not what was wanted so had to be done over again.

2. **Analyze Your Problem.**—In a telephone company trouble had been experienced in the maintenance of a certain class of equipment. Instead of carefully analyzing the problem to see just what

was the matter, weekly adjustments and tests of a very severe nature were made at a yearly cost of about $200,000. The trouble did not stop. More frequent adjustments and more severe tests were proposed. The trouble grew worse. Finally one executive with a more scientific trend of mind decided to study the problem so as to find out just what was the matter and to determine the extent of the effects of the trouble and how it could be eliminated at the least possible cost. Upon analysis it was found that the so-called trouble had comparatively no effect upon the telephone service and that attempt was being made to maintain equipment in such a state of perfection as to be not only unnecessary but wasteful and inefficient. To prove this he had certain equipment adjusted and sealed for a period of a year. Results showed that the service with that equipment was, in fact, more satisfactory than with the equipment given the weekly test at such a high cost. The result was that certain simple adjustments of equipment were made and a standard test devised to be given every six months. This was a case where analysis showed that difficulties were being made and constantly added to just because the problem was never analyzed.

The case of a firm that failed due to lack of analyzing their problems was that of a concern that went into the business of manufacturing hats. Instead of making a careful analysis to determine the kind and style of hats, and instead of taking into consideration the seasonal demand in that industry, the firm put all its efforts into the manufacture of cloth hats with the result that as felt instead of cloth hats were then the demand of the market the company failed.

A neckwear manufacturing concern, on the other hand, made a very decided success from the very start, mainly because they defined their purpose and analyzed their problem instead of rushing into business unprepared. They conceived the idea of opening a plant in Europe for the manufacture of knitted ties as well as "four-in-hands." As they were already well established in New York, the analysis showed that in their case many points which would have had to be considered for a new concern were already taken care of for them due to their experience in New York. The main points to be considered were the place of location, requirements and supply, the problem of labor and the selling area. Through careful analysis of all influencing factors they solved their problem briefly in the following manner:

(a) *Place.* Switzerland was chosen as the best fitted country for their plant for the following reasons:

1. Industry free from taxes.
2. Very few competitors.
3. Nearness to Germany, the source of all their equipment.

(b) *The Labor Problem.* They brought the necessary experienced men from their plant in the United States. They found an abundant supply of inexperienced labor to be had at very low wages. No labor trouble occurred as the Swiss people are a peace loving nation and not used to strikes or similar labor difficulties.

(c) *The Selling Area.* They chose Switzerland, Italy and England for their nearness and because their demand for a foreign necktie was large. The venture was a complete success.

3. Seek the Facts.—A hat manufacturer finding that he was making a very small margin of profit decided to cut costs, so he instructed his cutter to save on the cost of material by cutting a little shorter certain parts needed for the making of a hat. The expected saving proved instead to be a loss as considerable more time had to be taken by the operators as the small pieces could not be readily handled. If the hat manufacturer had sought the facts instead of jumping to conclusions he would not have made such a mistake.

Another instance was that of a road construction job operating under all sorts of difficulties; it looked as if the job could only be completed at a heavy loss. The engineer in charge was transferred and a new man took his place. He sought the facts, found that the trouble was due to several causes, chiefly the following:

(a) Insufficient number of trucks—therefore men had to remain idle waiting for trucks to load.

(b) A gasoline scoop was being used where there should have been a grader capable of cutting to a very fine grade. The shovel cut to within four inches of grade necessitating much filling in and rolling after the cut had been made. This materially increased costs.

(c) Lack of adequate supervision. The men were careless, and as they were not properly supervised, the clay drain pipes were broken in handling, and all work was done in a lazy, slipshod

manner. With the facts before him the necessary changes were made and the construction job completed at a good margin of profit.

4. **Devise the One Best Method.**—In a machine shop making bearings a machinist would have to stop his machine at frequent intervals and with the aid of another employee lift a heavy bar of steel in place. After studying the problem to find the best method to employ, a chain lift was installed for moving the steel. The result was considerable saving in time and energy and increased output.

In making the steel frame for a canvas basket it was necessary to heat the ends of upright pieces and "wrap" them, while hot, around a hoop of the same material. Sometimes the steel would cool before the men could wrap it securely; other times the uprights would be heated to too great a temperature and the ends would break off. The operation was tedious, dangerous, and inefficient and increased the cost of the finished product considerably. Then, too, when the canvas had been placed on, it made a bulky spot and the basket quickly became worn out when friction took place at this point. Various schemes were tried to perfect the frame before they devised the following method which apparently has solved the problem. A five ton press makes a U at the correct intervals on the top of the frame and by changing dies the same press bends the upright pieces over the indentation thereby doing away with the wrapping while hot and making a much more substantial frame. This was a case in which the one best method had to be determined in the conservation of energy, time, space and material in relation to the master task, that of making a substantial steel frame.

5. **Find the Person Best Fitted.**—In a furniture factory where there is a marked absence of labor troubles the principle of finding the person best fitted has been carried out unusually well. For instance, they know Brown is at his best working at his bench assembling the work together, Jones is best on the spindle shaper, and Smith on the hand-saw, and so on. While most of the men in the shop could work on any one of the machines, each is placed where he is best fitted for the work. Likewise, they appreciate that some persons are suited for repetitive work while others with a different temperament could not endure the monotony. In one instance an apparently hard-working and alert young fellow was taken off a

billing machine and given a position of more varied and interesting work with greater responsibility and more pay. After a few weeks the young man asked to be returned to his former work for as he expressed it he did not like the worry of responsibility. He liked to keep on doing the same thing over and over as in his former work.

The following example shows how the finding of the person best fitted is even more important in positions of high authority. A large steel manufacturing concern induced the owner of a smaller plant manufacturing a similar product to sell his own plant to them and become their general works manager. This man was an exceptionally capable engineer, and was apparently well equipped as an executive. Because of his well-earned record he was selected by the larger plant and in addition to a handsome salary he was given a large bonus. Great things were expected from him by his new firm. He would build up production in their great plant in proportion to his acknowledged success with his own smaller one. In just one year he was given an additional year's pay and his immediate resignation was requested by the board of directors. The reason was obvious to all except himself. He could not agree with plant policies, nor could he refrain from interfering with the engineering, financial or sales departments. All of his business life he had controlled a one-man plant. He had supervision of all departments. Here in his new position, even though at an increased compensation, he was simply general works manager. In spite of his ability this man was not the person best fitted and the company had to write off approximately $250,000 for their mistake in his selection.

6. Teach the Person Best Fitted the One Best Method.— Many companies, after selecting those they feel are best fitted for a particular job, give those persons a regular course of instruction. The New York Telephone Company, for example, gives the men chosen a six weeks' course in which they explain the whole organization and telephone system, and in addition give an extensive training in the particular line of work for which the individual is chosen.

The training described by the American Express Company for the drivers of their motor trucks falls under the following headings:

(a) Instruction in the mechanism of the truck with particular emphasis on the importance and care of such parts as

brakes, steering gears and lights which are directly related to safety.

(b) Instruction in details of safe driving.

(c) Stimulating the interest of drivers in safe driving.

The following example brings out forcefully the importance of teaching the one best method even in the simplest operations. In a clothing factory a study revealed that in such a simple operation as creasing arm-hole seams six different methods were in use among the eleven operators working on the job, and the best of them turned out the work over 2½ times as rapidly as the poorest. After a careful time and motion study a standard method was decided upon and the workers so instructed. After a short period of careful training their efficiency was increased to such an extent that four workers were relieved for other work.

7. **Plan Carefully.**—In the furniture factory referred to under principle five, the sequence of work is so planned that once the planks are put into the factory they will work steadily through and not have to double back after certain operations. The planks are taken in from the yards to the swing saws where they are cut to the length desired, thence to the rip-saws where the lengths are cut to the desired width. From the rip-saws a certain predetermined number go to the turning lathe, others to the jig-saw, and still others to the band-saws. The pieces from the band-saws then go to the sanding machines—the small pieces to the spindle sander and the larger pieces to the drum sanders. From these sanders they are taken to the disc sanders where the sides are sandpapered. They are then taken to the benches where they are assembled and take their final form. From here the article of furniture is taken to the varnishing room where it receives its color and polish.

The necessity for careful planning in a boiler factory is even more apparent. Boilers are very heavy and it is a costly proposition to shift them back and forth through the plant. Where there is a careful planning of arrangements and sequence of work the first operation, that of laying out the boiler, takes place near where the materials are stored. The boilers then move by traveling cranes from operation to operation until the last ones of testing, painting and welding. The finished boilers are then moved to storage in the yard until time to ship them, so as to be near the freight cars.

8. Win Cooperation.—The winning of cooperation is one of the hardest tasks, and is a principle the necessity for which is very frequently lost sight of. The absolute necessity of winning cooperation was conclusively demonstrated in the case of a flour mill located near Buffalo. All factors of plant location, equipment, labor supply, available raw material, and so forth, were well provided for and complete success was predicted for the enterprise. Unfortunately, however, one of the largest stockholders insisted upon being appointed general manager. He was a capable man in many ways but was unqualified for the task of welding the organization into a smooth working unit. There was constant friction between departments and everyone seemed to work at cross-purposes to everyone else. Expected profits turned out to be losses. The general manager resigned and in his place was appointed a man with a broad knowledge of the needs of the business and a good personality—the type of man that men like to work for. The dissension disappeared, the men under his leadership got to know one another and to appreciate one another's problems, and the result is a smooth running, expanding and profitable business.

An unusually difficult case of winning cooperation was that of a young man of 30 years of age who was placed in charge of a machine shop where the men on the whole were much older than he was, and where the man he replaced was twice his years. He was greatly handicapped not only by the question of age but also due to the fact that the men felt that one from among them should have received the position. The young man quickly perceived the feeling against him but decided to ignore it, at least for the time being, and to do his utmost to get the men to like him. He made it a point to meet the men even more than half-way, and yet to conduct himself so as to win and hold their respect at the same time. He found that the men had never been told just what was expected of them or whether they were above or below par. He kept accurate record of every piece of work turned out and showed the men their record. In this way he set up a friendly rivalry among the workers, and before long the men found themselves liking him even against their will. Soon he had their wholehearted cooperation. By the end of his first year these same men were turning out 25% more work than the year previous.

CHAPTER VI

ANALYSIS OF THE INDUSTRIAL PROBLEM

Analyze the Problem Step by Step.—No book can solve the problem of launching an enterprise for you. The best possible text can only state principles and give suggestions to point the way. Likewise precedent, while valuable, may be restrictive, and in some cases does much harm if too closely and blindly followed. Custom is a most difficult thing to get away from. The untried brings with it an element of doubt, of uncertainty as to outcome, and yet progress demands that we break away from inefficient methods that are being placidly accepted because it is the custom to do so. In launching a new enterprise, what then is the first thing to do? It is to form clearly in mind what it is you intend to accomplish. Then with the aim in view study the problem from every conceivable angle and bring to your study all available knowledge relating to it. The time spent in such a study is never wasted. The old adage, "A thing worth doing is worth doing well," holds true at this point above all others. A weakness detected before the enterprise is launched may be readily corrected, while later it may undermine the entire organization, and turn apparent success into failure.

The problem, then, must be considered in the light of the product to be made, the building, machinery, and equipment required, the location of the plant, the labor needed, the supervision required for that labor, and finally the management, under which heading must be considered not only the centralized control of the company but also the financial, selling and manufacturing elements. Here must be considered that important question of capital. What is the available capital? Just what will be the financial strength of the proposed company? Miscalculations on this point are very fertile sources of failure. One rarely overestimates the amount of capital required. It is a very common error, however, to underestimate. The only safe method is to allow a liberal margin of safety in making your calculations.

A Contract That Brought Failure.—A newly incorporated firm of construction engineers felt very proud at having secured in the face of keen competition the contract to build a large bridge. They rather crowed that they had secured the contract "from under the very noses" of several old established construction firms. They did not laugh, however, when they found that, due to encountering quicksand and other unexpected difficulties, construction costs were far greater than they had calculated upon, and that their capital was not sufficient to swing the project. The failure of their firm, with subsequent heavy loses to themselves and to their creditors was to a considerable extent the result of lack of sufficient attention to the financial element.

The following discussion will give an idea of what should be included in an analysis of the problem of starting an industrial enterprise. The relative stress to be laid upon the various items will of necessity vary with the individual concern.

The Product

The product should be considered in the light of its nature, its value, the probable demand—in other words, the estimated volume of sales, and the extent of protection afforded it by patents, secret processes of manufacture, tariff restrictions, etc.

1. Nature of the Product.—

(a) Luxury or Necessity.—If a luxury, may it develop into a necessity? If a novelty, how long will the demand last? When automobiles were first introduced they were looked upon as the height of luxury. Yet in a comparatively few years their sales so grew that the report of the Department of Commerce shows that in the year 1925, 4,157,830 motor vehicles were produced in the United States at a wholesale factory value of $2,934,488,639.

The answer to the question of whether a product is a luxury or a necessity determines to a great extent the treatment of your problem. It would obviously be foolhardy to invest a considerable sum of money in developing a concern to manufacture a luxury that could be afforded by only a comparatively very few persons. This is so for at least two important reasons. First, the field of probable demand would be very limited, and second, and equally important, those who can afford such costly luxuries are very likely to be so

surfeit with them that it is hard to hold their attention. Something new is so apt to come up and the whim of fashion turn overnight in the direction of the new.

(b) Requirements of the Public.—An analysis made from the viewpoint of the purchaser brings out unsuspected defects or weaknesses, as well as modifications needed to meet competing articles. Again taking the example of the automobile. In 1916 only three cars out of every 200 built were of the closed type, and the closed car was considerably more expensive than the open car of the same standard. As people became more familiar with cars they saw the many advantages of the closed car for all-year-round service. Realizing that the requirements of the public called more and more for the closed type, certain far-seeing manufacturers put out a model of the closed type to sell at a price more nearly that of their open model. The result was a greatly increased volume of sales for those concerns, others followed their lead, and by 1927 out of every 200 cars built 166 were of the closed type.

(c) Physical Properties.—Under physical properties would be included the character of the product, whether substantial or fragile, the size, shape and weight. Such an analysis has a direct bearing upon the location of the plant, the type and construction of the buildings required, the equipment and devices needed for handling materials, the transportation facilities, the storage facilities and the class of labor required. It is at once apparent that the plant, equipment and labor required for the making of iron castings would be totally different from that required for the manufacture of watches.

(d) Difficulty of Manufacture.—This has a bearing upon the technical knowledge, supervision and labor required and the equipment necessary. One of the large automobile manufacturing companies found when putting their new design for a spare tire carrier into production that the direct labor cost was double what it should be. By slightly changing the design, thus eliminating some of the difficulties of manufacturing, direct labor cost was more than cut in half, yet the tire carrier produced was entirely satisfactory.

2. **Value.**—Under this heading are considered the probable cost and selling price. Will the price be low enough to be within reach

of the masses, or will it be prohibitive except for a few? What price competition will have to be met? These are two of the questions under the heading "Value." The "value" of the product has a direct bearing not only upon the financial policy of the company, but upon the sales and production policies as well.

The popular demand for automobiles is in the $1,000 or under class. For a concern entering the automobile manufacturing field it would seem logical, therefore, to enter into this $1,000 or under class. On second consideration, however, and after a thorough study of present cars selling at that price one would realize that here competition is exceptionally keen, and that it would take a car of unusual merit to successfully enter this already crowded field. Production would have to be on a large scale in order to keep manufacturing costs down to the point where a good profit could be made. This would involve a large plant and a considerable outlay of money for equipment, material and labor. The sales organization would have to be an unusually efficient one in order to meet the already well-known and highly developed sales organizations of the established concerns. All of this would require considerable capital, so that the concern without sufficient sound financial backing would be doomed to failure from the very start.

3. **Volume.**—By a market analysis a forecast can be made of sales possibilities not only for the immediate future but for expansion in the years to come. This would have a direct bearing upon the location, size and type of plant, the amount of equipment and machinery required, and the financial, sales and production policies.

Three young men, each with a little capital and with practical experience in the textile field, decided to incorporate a company and to have a mill of their own. By a careful market analysis they ascertained that for a number of years to come there would probably be a good market in their immediate vicinity for velour to be used in draperies and upholstery. That their analysis was correct was demonstrated by the fact that within a very few years they were able to pay off the mortgage on their plant, and even to further expand the business. The success of their firm proves beyond the possibility of a doubt the value that can be derived from a scientific analysis of an industrial problem. They gave very thorough attention to every phase of the problem and were rewarded by suc-

cess, even in the face of the fact that the textile industry on the whole was not in a very strong condition, and that their capital to begin with was discouragingly small.

Kind of Shop.—The above three factors—nature, value, volume—determine whether the factory will be a jobbing, specialty or mass production shop turning out a single kind of product. A job shop is one in which all or at least the greater part of the work on each order is performed separately for that order and in accordance with the customer's specifications. There are some shops that will make almost anything in their line that their sales force can sell. Thus a job machine shop to meet the needs of a customer may make a machine totally different from any they have ever made before. On the other extreme we have the shop that makes but one product on mass production, as for example, the Ford Motor Company. The kind and size of shop determine the equipment, whether general purpose machinery or special machines designed for the utmost efficiency in performing one particular operation. Likewise with the question of labor. In the mass production shop the greater percentage of workmen would of necessity be specialists in their particular job, while in a jobbing shop a large percentage must be all-round men capable of performing various operations.

Likewise with the kind and volume of material on hand, both raw material, material in process and finished goods. The jobbing shop, due to diversification of product, keeps its inventory down to a minimum, frequently buying the necessary raw material after it has secured the order. In the mass production shop raw material requirements for a given period can be definitely known and prepared for in advance. Inventories, therefore, are likely to be larger and favorable buying terms can be secured through quantity purchases and taking advantages of market changes. The need for a careful analysis of the product is therefore evident and will be even more so as the discussion proceeds and it is realized how the results of this analysis have a bearing upon all the remaining factors.

4. **Protection.**—In considering the product to be manufactured, an item of importance to many concerns is that of the protection afforded by patents, secret processes of manufacture and tariff restrictions. The law provides that for certain new or improved articles and processes a patent may be secured granting a monopoly for a

definite period, with the privilege of extension beyond this term under certain conditions. The person or concern, therefore, that has contrived a new device, found a new use for a known device or has made a new design of some useful product can make an application to the patent office for a patent covering the invention or design. A full description and, where possible, a drawing or working model must accompany the claim so that all new or novel features are clearly set forth. In every case it is desirable to secure a basic patent. A basic patent covers the fundamentals and permits the holder to have additional patents issued from time to time as he further develops his product or process. A basic patent, furthermore, protects the holder from unscrupulous individuals who otherwise might use the patented article as a model and change it just enough to permit them legally to manufacture and sell it. The person or concern that is granted a patent upon a meritorious new product has an enviable position as his monopoly limits the competition which he has to meet and enables him to hold his field until something appears that is an improvement or advance over his product.

Where the product or process of manufacture due to its nature is unpatentable, protection can only be secured through keeping secret the process of manufacture, and by the use of methods superior to those employed by competitors.

On certain articles which can be manufactured abroad and imported here cheaper than they can be manufactured in this country a protective tariff is imposed in order to help to build up the home industry. Regardless of the benefit or detriment to the country as a whole, the tariff is of benefit to the industries which it protects from foreign competition, and is therefore a factor to be considered.

Equipment

Equipment Required.—After a thorough study of the product has been made and a definite determination of the processes of manufacture required and the sequence of operations, it is next in order to find out the classes of machinery or equipment that will perform the needed work. From these classes select those best suited for the purpose. It would be impossible in this brief discussion to state just what types of equipment are best suited for the specific needs

of any industry. The requirements of each plant are different and each case must be decided for itself. Care should be exercised in the selection as equipment usually entails large expenditure and determines to a considerable extent the efficiency of production. Those best suited are not necessarily the most expensive or the "best seller," but are the ones which will perform the work required more quickly, more accurately and economically than any of the others.

Standard Machines vs. Special Machines.—Standard machinery and equipment should be used wherever practicable. The following are some of the factors which will determine whether to use general purpose or special machinery.

1. Initial cost. General purpose machines ordinarily are less expensive.

2. Extent of standardization of the product. The greater the extent of standardization, the greater the advantages of special machinery built to fit the particular needs most fully.

3. Likelihood of changes in the manufacturing program. After changes the special machinery may be useless.

4. Low resale value of special machinery. The decision to buy a special machine should be based upon the assurance that it will pay for itself in a reasonable length of time.

5. Cost of maintenance and repair parts. Repair parts are less expensive and easier to obtain for a general purpose machine—therefore less time and money are lost in making repairs.

6. Special machinery may be more expensive to operate as skilled labor may be required.

Number of Machines Required.—The number of machines required in each class of equipment is dependent upon a number of factors, chief among them being:

1. Volume to be produced by the particular machines. This should balance the capacity of the machines or groups of machines in the next preceding and next following operations.

2. Capacity per machine.

3. Number of plant working hours. Here must be considered not only the length of the working day but whether one, two or three shifts will be run.

4. Actual available machine time. Time lost in setting up machinery, frequency at which the set-up must be changed, etc., are

important factors and must be taken into consideration in computing actual available machine time. In one textile mill certain machines got out of order very easily. This so cut down available machine time as to necessitate having an additional machine of that type so as not to hold up production due to repairs.

5. Size of lots that will be put through. If material comes through in small lots and the machines are used for different purposes which necessitate a different set-up, this will reduce the available machine time per machine.

Quantity of Equipment.—The decision as to the type and quantity of equipment required is a most important one. The degree to which the equipment meets the requirements of the manufacturing process determines to a considerable extent the efficiency of the plant and the cost of production. Costly idle equipment, on the one hand, creates an excessive overhead burden, while, on the other hand, lack of sufficient equipment hampers and holds up production. The ideal condition is to have the exact number of each kind and type of machine required, each machine being operated to the limits of its production capacity and performing its function with maximum efficiency. This condition is rarely if ever found in practice. In many cases, however, it can be very closely approached through a proper balance of machines to eliminate bottle neck operations, and by having a full complement of auxiliary equipment and service. "Bottle necks" occur where in a productive unit there is an overbalance of one kind of machine or process and a shortage of another. For example, in a production unit making gears if all machines or groups of machines except one, say the operation of cutting the teeth, can complete operations on 1,200 pieces in a day and that one can only complete its operation on 950 pieces, then the capacity of that production unit is limited to 950 pieces and the bottle neck is at the operation of cutting the teeth.

Material Handling Equipment.—One of the largest items of cost in manufacturing is the cost of handling materials. "In a study conducted by Mr. Max Sklovsky, of the handling operations involved in the production of iron castings in a foundry it was found that, on the average, for each ton of finished castings produced, 168 tons of material of one sort or another were required to be handled." [1] This

[1] *Mechanical Engineering*, December, 1925.

Fig. 3-A. An empty carrier that will hold twenty pieces stands before each press, ready to receive the stampings as fast as they come off.

Fig. 3-B. Stampings literally flow in one steady stream from press room into the cleaning and painting department when day's work gets under way.

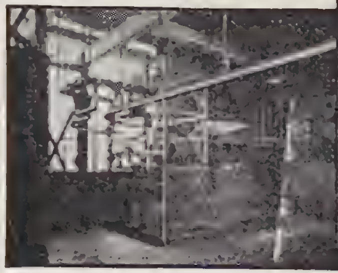


Fig. 3-C. An automatic Tramrail Dipping Elevator lowers a carrier load of stampings into the paint tank at one time.

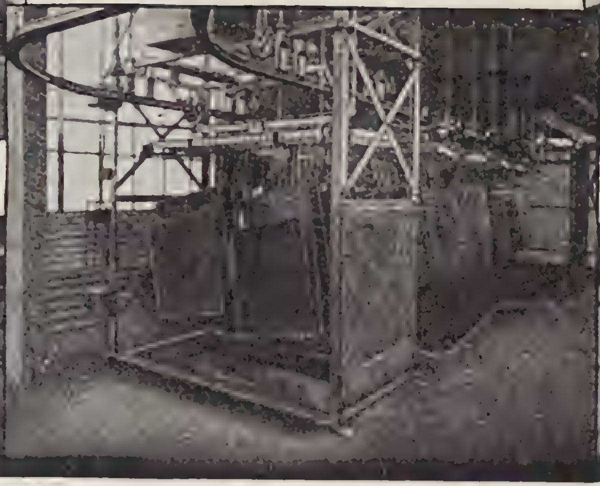


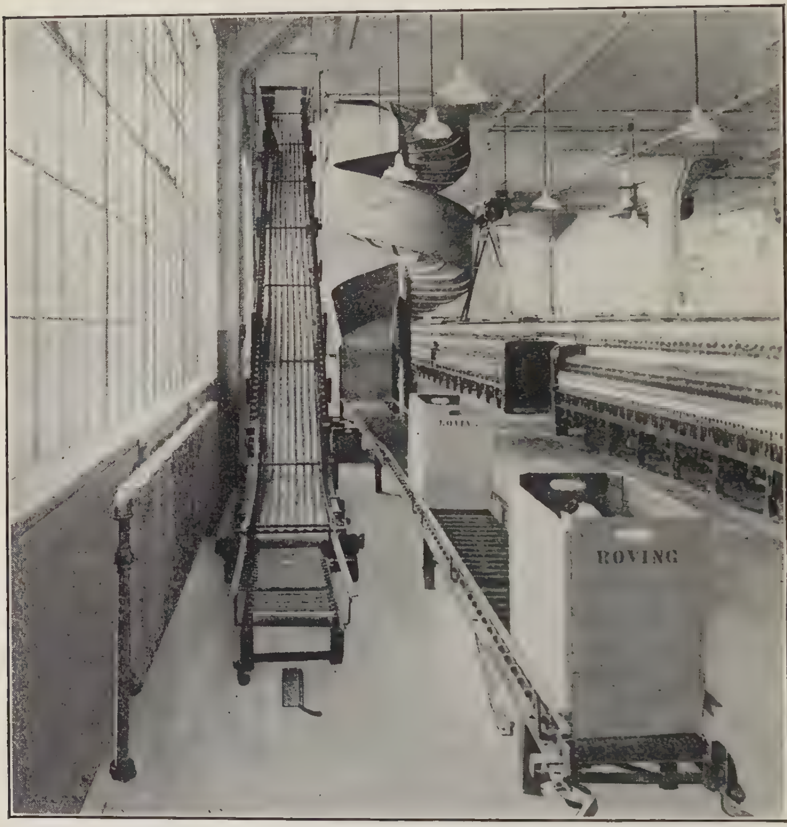
Fig. 3-D. An entire oven charge of stampings is shown here on the Tramrail System, ready for drying. Not a single piece has been touched by hand since they were hung upon the Tramrail Carrier at the presses.

Fig. 3-E. An entire oven load is pushed out of one end when a new charge is pushed in at the other.

(Courtesy of Cleveland Crane & Engineering Co., Wickliffe, Ohic)

Figure 3. Reducing Material Handling Through the Use of a Tramrail System

same condition in a varying degree applies to all industrial plants whether the plant is a machine shop, a clothing factory, a flour mill, or what-not. In planning a new plant or in making improvements in an existing one an essential feature, therefore, is to eliminate as far

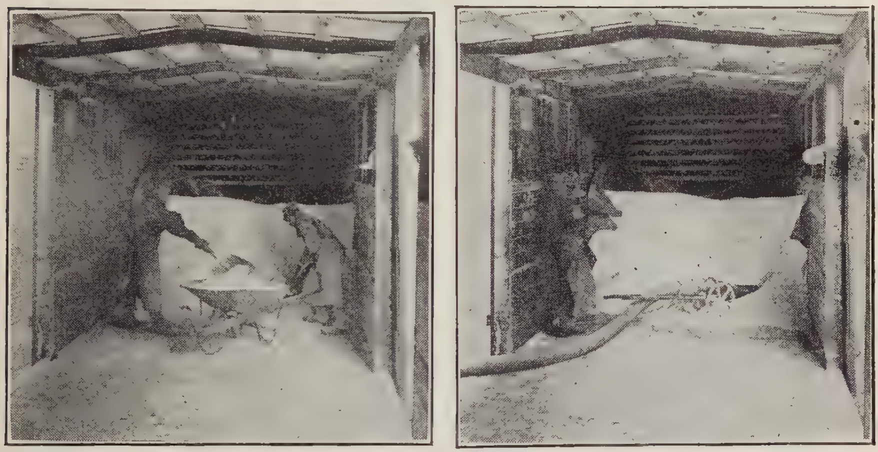


(Courtesy of Standard Conveyor Co., North St. Paul, Minn.)

Figure 4. An Installation in a Textile Mill. A spiral chute is shown discharging carriers onto a section of gravity rollers. The incline elevator on the left of the spiral chute is used for elevating the same carriers

as is practical the handling of materials and to do such handling as is necessary at a minimum of cost. The loss due to the operator slowing down or stopping his machine, leaving it, lifting or otherwise handling the necessary materials is not confined to merely the lost time on the part of the operator and his machine but even more im-

portant is the slowing or interruption of the production flow. The first and chief factor in economy of material handling is the proper layout of the plant so as to minimize handling operations (discussed later). The second factor is that of the substitution of mechanical means for manual handling. Often the wages paid in one year would be sufficient to purchase material handling equipment which would do the same work faster, better and cheaper for a long period of years.



(Courtesy of Holly Pneumatic Systems, Inc., New York)

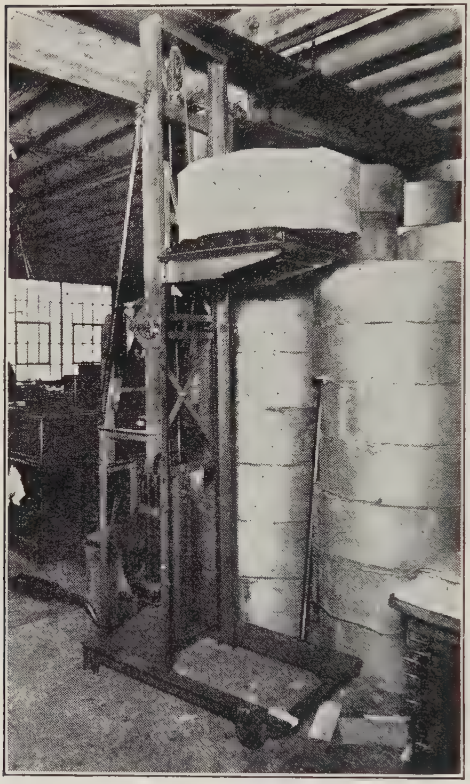
Unloading 12 tons of chemicals in 5 hours by hand from railway car

Unloading 12 tons of chemicals per hour from railway car by a suction conveyor

Figure 5. Reducing Cost of Handling Materials Through the Use of a Suction Conveyor

The material handling problem of a particular plant depends upon the type of industry and the peculiar conditions of that plant. It is at once evident that the problem in a continuous bulk industry such as that of the making of flour would be very different from that found in the automobile industry. In any case, however, mechanical methods often would be better and cheaper than manual effort. The big problem is in the selection of that equipment which will secure the desired results at the lowest cost. This does not mean that the equipment with the lowest initial cost should be the one selected. The point to be looked for is not initial cost, it is the service to be secured through the use of the equipment. Frequently, when it is thought necessary to increase the capacity of a plant it will be found that efficient handling methods will so increase the volume of produc-

tion with the present equipment and number of workers that no plant expansion is needed. In planning for a new plant sufficient handling equipment of the right sort will tend to reduce materially not only the number of employees required but also the amount of capital necessary to be invested in machinery, thus effecting a reduction in labor cost as well as in overhead charges.



(Courtesy of Standard Conveyor Co.)

Figure 6. Portable Elevator or Tiering Machine. A handlift is used by the Wirth Sales Book Co., Chicago, Illinois, to tier rolls of paper in narrow aisles

There can be no hard and fast rules used in selecting material handling equipment. While a wise selection requires an intimate knowledge of available commercial equipment, there is at the present time an ever increasing fund of information on the subject. Special order, complicated equipment is rarely as satisfactory as the more simple, standard equipment of reliable manufacturers. Equipment that has proved itself for similar work in other plants can usually be readily adapted to particular needs. Figures 3 to 6 show representative types of material handling equipment.

Buildings

Types and Construction of Buildings.—While for the sake of continuity and clearness in analyzing an industrial problem the

types and construction of buildings will be considered before that of plant layout, it must not be understood that they are totally distinct and unrelated subjects that can be disposed of irrespective of one another. The entire layout should be planned in detail before the actual work of construction is commenced. Likewise the final layout cannot be decided upon unless the type and construction are known, as due consideration must be given to the columns, walls and other fixed structures of the building. Similarly with the selection of equipment. The layout and material handling problem would be very different in a three-story building than in a single story. For example, with proper layout gravity conveyors in a multi-story building would in some cases readily and economically solve a great part of the material handling problem. This interdependence must continually be borne in mind in considering the various factors in the analysis. An ideal layout may have to be modified due to building restrictions, or building plans may have to be changed to meet some unusual layout feature. Invariably changes and shifts in plans will have to be made before the final plans are completed and approved.

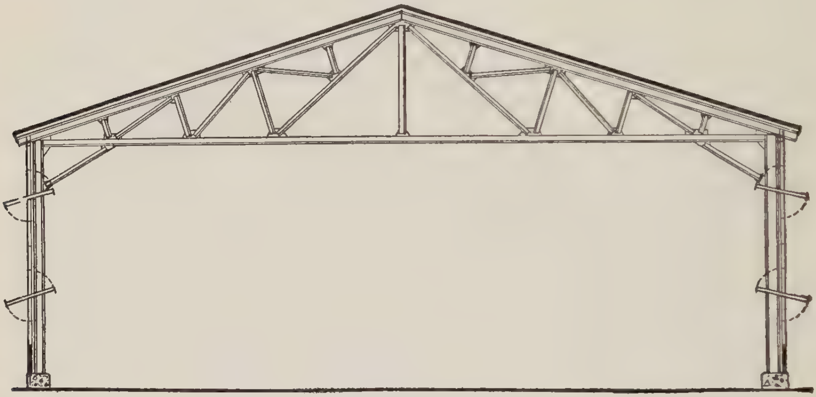
The type and construction of factory buildings depend primarily upon manufacturing considerations. A building once constructed is a fixed structure; therefore, it should be very carefully planned in order to see that every manufacturing requirement is met. After production has started, mistakes in building design and construction can rarely be remedied except at excessive cost, so must remain a constant burden.

Due consideration must be given to land values and cost of building construction, as the cost of the plant is a large item in overhead charges. These in turn determine to a considerable extent the selling price of the product and the ultimate profit or loss of the enterprise. Since the object in starting any industrial enterprise is to make a profit, this necessitates that the product be produced at the lowest cost consistent with the standard of quality set. Lack of sufficient thought to the relation between the plant and the subsequent profits to be made has had the unfortunate effect in many cases of having an unnecessarily fine plant with a resulting prohibitive operating burden which wiped out all profits. Buildings must be planned and constructed for the particular needs they are to serve at the lowest cost consistent with operating efficiency and cost of maintenance.

1. Types of Buildings.—

(a) Single-story.
(b) Multi-story.
(c) Saw-tooth roof buildings.
(d) Single-story with mezzanine floors in side bays.

Each type has its peculiar advantages and disadvantages. Frequently all four types will be found in one industrial unit, each type being used where it will most fully meet the particular needs.



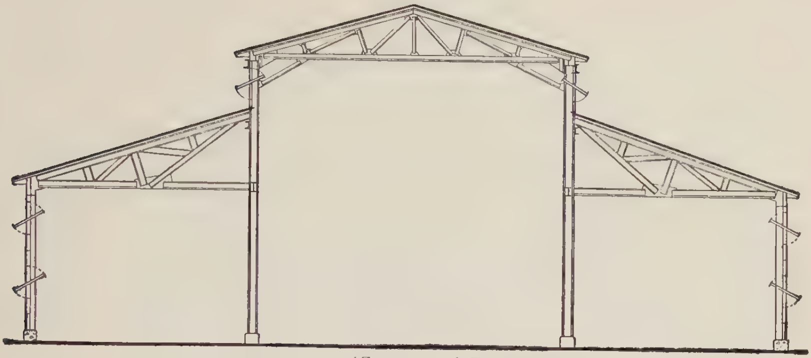
(Courtesy of Truscon Steel Co., Youngstown, Ohio)

Figure 7. Clear Span Type Building

Multi-story buildings are used in cities where land values are high. Single-story buildings which secure better light and ventilation but cover more territory are ordinarily employed in surburban locations where land is less expensive.

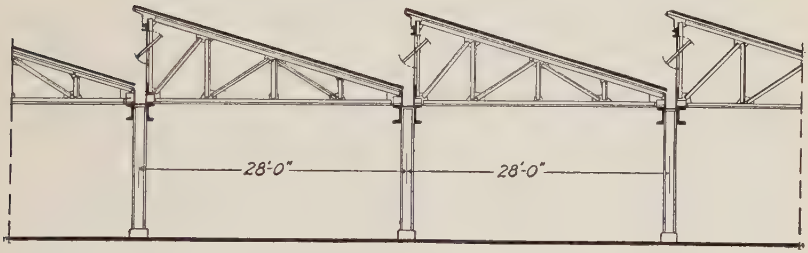
Where heavy materials and machinery are used a single-story structure is desirable, as heavy floor loads necessitate costly construction if the multi-story type of building is used. In addition, the handling of heavy materials from floor to floor involves considerable expense in the form of equipment and labor. In the case of lighter materials where the force of gravity can be utilized, the multi-story type may be the more desirable as the handling of materials is an important factor in the cost of the finished product.

The saw-tooth type of roof is of decided advantage in supplying daylight lighting and good ventilation, even in rooms of great size.



(Courtesy of Truscon Steel Co., Youngstown, Ohio)

Figure 8. Monitor Type Building



(Courtesy of Truscon Steel Co.)

Figure 9. Cross-Section Saw-Tooth Type Building

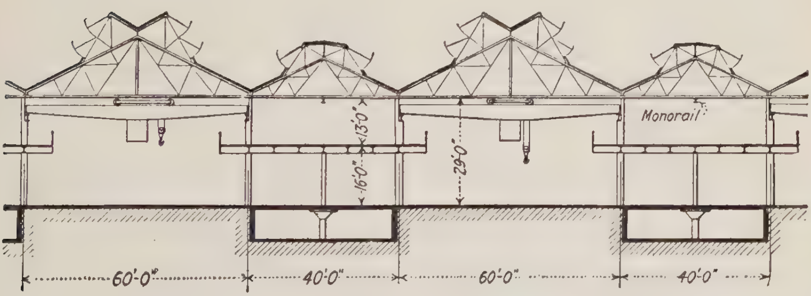


Figure 10. Cross-Section of Manufacturing Building, Showing Bay and Balconies. Combination type building (part of the plant of which the general plan of the entire plant is shown in Figure 11)

From *Management Engineering,* Vol. 2, No. 3, page 168, by Paul L. Battey.

Figures 7, 8 and 9 show various types of construction. Figure 10 shows a possible combination of types.

2. Building Construction.—Reinforced concrete and steel frame construction are rapidly supplanting the old wood and brick mill construction types as they have a relatively low cost of construction, can be made fireproof and permit of the greater part of the wall space being given over to window space. A number of structural steel concerns have designed standard building units. With careful planning, a selection and combination of various styles and types of units may be made so that the building constructed will fit special layout needs and be ready for use in a minimum of time and at a comparatively low cost.

Layout.—The layout of a plant depends primarily upon the processes required in the manufacture of the product, and the movement of material from one process and operation to another. In other words, the layout depends upon the flow of work in that particular plant. The ideal layout is one which provides, all factors considered, for the most efficient sequence of operations. The test of any plant is first its usefulness. Does it fully meet the need for which it was built? Second, its simplicity. Simplicity brings with it a directness of effort, a reduction of cost and an ease of operation and control. How often a problem is made more difficult than it really is. Complicated methods are devised at great expense of time and effort and the result looked upon as an achievement due to the very complexity, whereas a simple method would far better fit the need and cost less to operate. Usefulness and simplicity, therefore, should be made the keynote of plant layout.

All will agree that it would be the height of folly to have heavy machinery on the upper stories of the factory building and light machinery on the lower floors, as it would entail expensive plant construction to carry the load, costly transportation before and after machining, high maintenance cost through shafting getting out of alignment and so forth due to vibrations of operating machines, waste due to floor space being taken up by supports for upper stories, and so on. Yet equally costly, but not so evident is inconvenience of operation and unnecessary trucking and material handling which go on every day in many plants due to improper planning of plant layout.

It would hardly be practicable in a study of this scope to treat in any adequate way all of the factors involved and the procedure followed in planning the layout of industrial plants. Such a treatment of the subject would necessitate a complete study in itself—and then could not be expected to be inclusive as each industry and each plant within the industry presents problems peculiar to itself. The following is intended merely to give an insight into the general principles followed, the main factors considered, and their effect upon the final plan. While the straight line layout is an ideal condition well worth striving for, continual compromise of the ideal is necessary due to restrictive influencing factors which must be taken into consideration in order to have a good, workable final plan. The following are among the main factors to be considered in planning the layout of the average industrial plant. The relative weight of the factors varies with the particular plant.

1. **Processes of Manufacture and Sequence of Operations.**—As the ideal layout is the one which provides, all factors considered, for the most efficient sequence of operations, the processes of manufacture and the sequence of operations is the first and most important factor to be considered. This permits of determining the departments needed to carry on the various kinds of work involved in the manufacturing process and a logical arrangement of departments, properly balancing them so that each department can take up the production of the previous department, and, in turn, pass over its production to the following department. A graphic chart drawn at this point showing the flow of work and the relation of departments while only of a tentative nature affords a tangible starting point for the layout plan. Such a diagram is referred to as a "flow sheet" or "flow chart."

2. **Special Requirements of Certain Departments.**—Practically every department has certain specific needs peculiar to itself which must be taken care of as their omission may prove a serious detriment to the operating efficiency of the department, and in some cases affect the departments located near it as well. As certain of these requirements may necessitate special features of construction they must be provided for before actual construction work begins. For example, an extra hazardous process may have to be housed in a specially designed building removed from the main factory building,

yet so placed as to be convenient to those departments which it is to serve. Other processes such as bleaching or rust proofing of metals are accompanied by acid fumes and so must be located where they may have special ventilation and where they will affect as little as possible the workers in other departments. Dye houses and tanning vats must be located on the ground floor because of the heavy weight and of the wetness of the operation. On the other hand processes demanding an unusual amount of natural light should, in a multi-story building, be located on the top floor where by means of a saw-tooth roof or a roof composed mostly of glass, or by a skylight the required amount of light may be secured. Any of the above requirements, and many others, due to the nature of various processes, are likely to be present in industrial enterprises. Their presence therefore must be recognized and provided for in planning any successful layout.

3. The Number of Machines and Their Grouping.—As the number of machines determines the rate of flow of work, the number of machines and their grouping are factors of considerable weight. A straight line layout implies the processing of the product in one direction from the receipt of raw materials to the shipment of finished goods. Many practical obstacles stand in the way of such an industrial ideal, which is rarely if ever achieved. One is where the same kind of machine is used for two or more operations with several other operations intervening. Where each operation requires the full capacity of the machine, the solution is an easy one, namely, the purchase of two machines or more, as the needs indicate. But where neither operation requires the full capacity of the machine two methods are open. The first is to purchase a machine for each operation. As the machines are likely to be costly, this method, if used indiscriminately, increases the capital invested all out of proportion to what it should be, and entails an excessive overhead burden due to idle machinery. The second method is to move the material back to the machine. This has the decided disadvantage of breaking the straight line flow of material and increasing material handling costs, but upon analysis may prove, in many cases, to be the more economical method of the two. Here, then, is a compromise with the ideal straight line layout.

The ideal number and grouping of machines provides that each

operator is kept busy doing production work every working minute, that each machine is likewise busy every minute, and that just the right amount of each part or each kind of material is produced at all times so that work moves through the plant in accordance with a definite schedule permitting continuous uniform shipments of the finished product. By careful planning this ideal layout can be fairly closely approached in some of the continuous industries, such as the bleaching and finishing of cloth. In assembly industries, however, such as the manufacture of automobiles, machine tools, watches, and so forth, where it is not at all uncommon to manufacture a dozen or even a hundred or more models or products with a hundred or more different parts, the layout is considerably more complicated. If such a plant is laid out to give a straight line layout for one model or even one group of parts, it might seriously affect the efficiency of the layout as regards the production of the other models or parts. Here again is present the necessity for compromise.

There are in general two methods of grouping machines:

(a) Kind or process grouping. That is, all lathes in one department, all planers in another, all drill presses in a third, and so on.

(b) Product grouping. Under this arrangement all the machines needed to make a product will be grouped together into a production unit, the various types being placed in the order in which they will perform their operations on the product. For example, in machining a steering knuckle for an automobile the grouping might be drill press, lathe, wet cylindrical grinder, sensitive drill, threader. Broadly, the advantages and disadvantages of each method are as follows:

Kind or Process Grouping:

1. Advantages:
   - (a) Reduces the amount of equipment required. Only sufficient equipment of a kind need be provided to take care of the total factory needs. This not only reduces the capital required but also the overhead charges.
   - (b) Foremen become expert in handling one kind of equipment and can train their operators to turn out high quality work in large quantities at less

cost than if they were working on a wide range of operations.

(c) Uniform standards of workmanship on all similar work.

2. Disadvantages:

(a) Increases material handling. Work moves from department to department. A part may have to be returned to the same department several times. This greatly increases costs, adds to confusion and slows up the flow of work.

(b) A breakdown of a department may hold up production of the entire plant.

(c) Responsibility for production of the finished part or product is divided among many thus increasing the difficulties of interdepartmental relations and control.

Product Grouping:

1. Advantages:

(a) Continuous line layout eliminates excess material handling and permits of an uninterrupted flow of work based upon a definite schedule.

(b) A breakdown in a production unit does not interfere with the work of other production units.

(c) Accurate costs are more readily determined as the entire product is made in the one production unit.

2. Disadvantages:

(a) Increased equipment required. With the same kind of equipment used at several points all machines are not so likely to be utilized to capacity. Idle machinery is a fertile source of industrial waste.

Grouping by kind or process is ordinarily employed in special order work and in plants turning out a variety of products. Grouping by products effects the greater economy of production in continuous industries and in other industries where there are only a few products produced in volume. In such plants where the processes are well standardized and the same material goes through the same operations day after day and week after week, the work is so scheduled that

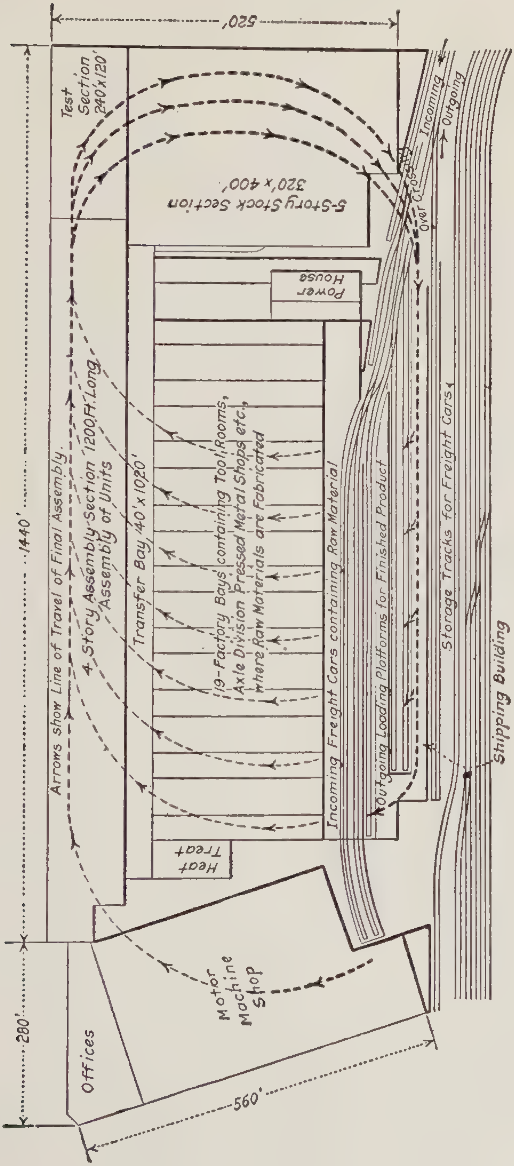


Figure 11. General Plan of an Entire Plant Showing the Routing and Travel of Material
From *Management Engineering*, Vol. 2, No. 3, page 168, by **Paul L. Battey.**

all machines are busy simultaneously and the disadvantage of the product method of grouping, namely, danger of increased equipment beyond specific needs, is practically eliminated. Such an instance is found in the automobile industry where product grouping has been a big factor in reducing costs. Both arrangements, however, are usually found in the same plant. Even where departmentalization by product is the general rule certain departments and operations are often made exceptions. For example, steel storage and cut off, casting and forging, painting, etc.

4. Auxiliary Equipment and Their Relative Position to the Machines They Serve.—As an example of the influence of auxiliary equipment we will choose the equipment that drives the machines, as the type of drive used determines to a considerable extent the layout of machines. The individual motor drive method with an individual motor for each machine permits of the machine being placed in any desired position. As this method is high in first cost it is used mainly for machines requiring large amounts of power, such as heavy duty machine tools, printing presses, and so forth. Where power using machines are grouped together and driven by belts from a line shaft by a single motor using a countershaft for each machine the method is not so flexible. As the belts are driven by pulleys on the shafts, the drive naturally must be at right angles and the machines arranged parallel or nearly so to the shaft. If it is necessary to have other than parallel layout of machines, then a special attachment must be used, which increases initial cost and the cost of maintenance.[2]

5. Space Required for Aisles and Storage Space.—In addition to the main aisles which should be made ample for all trucking requirements, there should be side aisles at right angles to the main aisle. While machinery should be placed with the idea of conserving space as far as possible, overcrowding must be guarded against as it lowers the efficiency of the workers and in some cases is actually unsafe as for example, with the placing of a metal planer where sufficient space is not allowed for the travel of the planer table. When the planer is running the table is moving back and forth and projects itself beyond the bed of the machine and into the aisle.

[2] For a further discussion see F. H. Penney, Group Drive and Individually Motorized Drive, *Mechanical Engineering*, January, 1926.

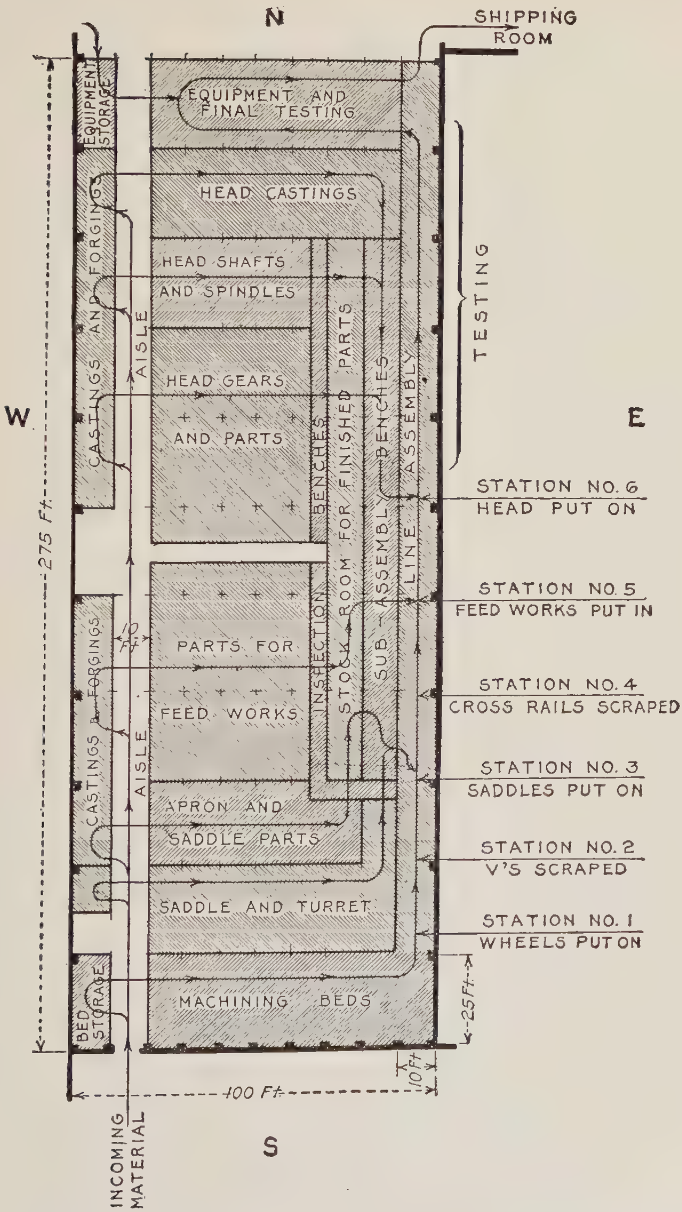


Figure 12. General Arrangement of a Turret Lathe Shop

From Ralph E. Flanders, "Design Manufacture and Production Control of a Standard Machine," presented as a paper, American Society Mechanical Engineers, Dec., 1924.

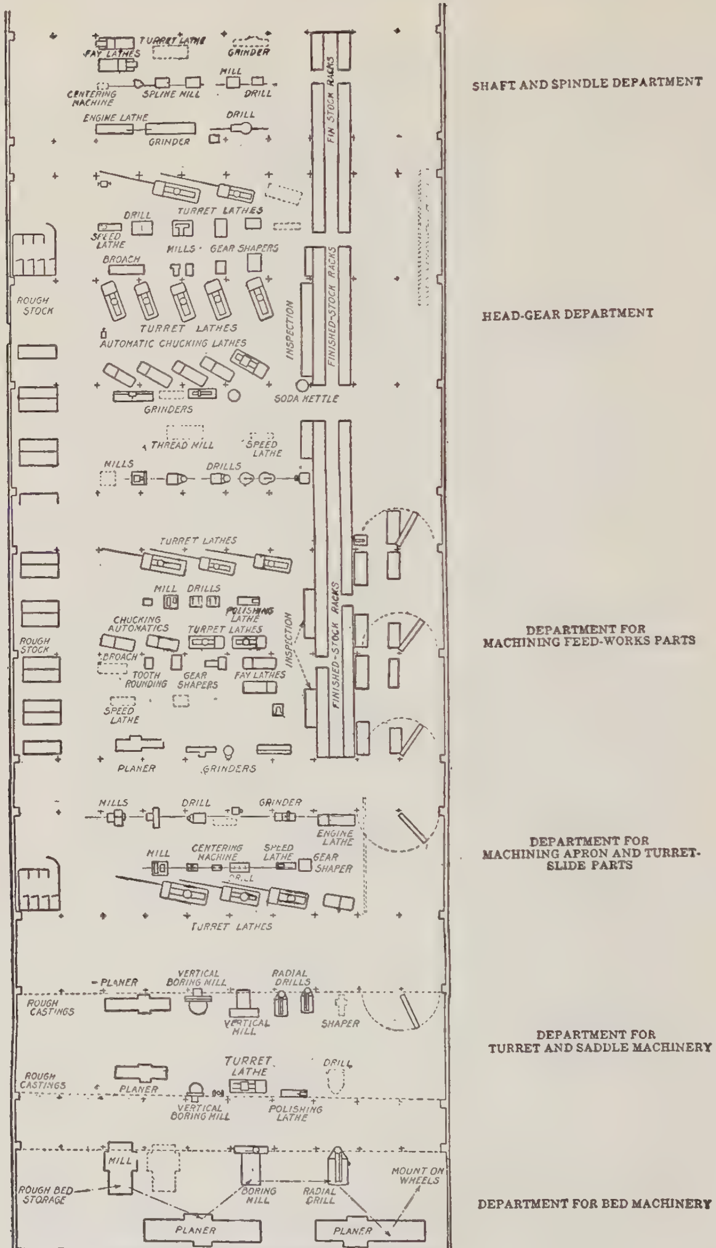


Figure 13. Detailed Layout of Departments Shown in Figure 12

Sufficient space around machines for raw materials, for that upon which the operation has been completed, and for the movement of material to the next operation, serves to keep the plant in an orderly condition and to keep the aisles clear. If the operator is crowded by raw and semi-finished materials he is very likely to become irritated and careless. A definite space provided for raw materials, and a definite space provided for material after the operation is completed tend to eliminate a lot of waste effort on the part of the operator in excess material handling and promote his general efficiency.

6. Space Required of Service Centers.—Service centers such as toolrooms, sanitary accommodations, and so forth, should be located where they will break up the shop area as little as possible and yet be convenient to the workers they are to serve. A number of small units are more easily distributed than a few larger units. In addition, being more of them the distance is shorter from the operators' workplaces to the centers serving them, so less time is consumed going to and fro. In some plants, where the construction of the plant permits, a good arrangement is to have the service centers on balconies between floors.

7. Space Required for Storeroom and for Finished Goods Awaiting Shipment.—A number of factors enter into the location of the storeroom. As the storeroom is primarily a service center for production, it should be centrally located with respect to the departments which will use the materials. This may necessitate a main storeroom with subsidiary storerooms located advantageously in several sections of the plant. Again, the nature and value of the materials stored and the rate at which they will be received and issued are big factors in determining the location. Coal would certainly require different treatment from diamonds, and yet both may be and are used in the same plants. Pulp wood to be used in paper mills, due to its bulk, is stored in the yard and taken in to the mill as needed. Wherever possible it is desirable to have the raw material storeroom and the storeroom that is used for the storage of finished goods awaiting shipment, both adjacent to the company's railroad siding. In a small plant the receiving docks and the shipping docks are one and the same thing. One medium-sized cushion spring manufacturing company has the raw materials stored at the storeroom adjacent to the receiving dock, thence the steel is carried by con-

veyors to the presses on the first floor where the steel is punched, cut and formed. It is then taken to the second floor where it is assembled with other parts. When the product is finished and ready for shipment, it is carried by a gravity chute from the second floor where the last operation took place down to the finished goods storeroom adjacent to the raw material storeroom.

8. The Necessity for a Railroad Siding.—Where shipments are received or made in carload lots, a railroad siding becomes a necessity and must be taken into consideration in planning the layout as it determines to a considerable extent the location of the storeroom and stockroom. A disregard for this factor caused one concern to truck its incoming and outgoing shipments to and from the railroad cars, thus materially increasing handling costs.

9. Restrictions of Buildings and Fixed Equipment.—Even in cases where the buildings are designed for the special purpose which they are to serve, there are certain limiting factors such as columns, walls and other fixed structures which must be considered in planning the layout. In adapting an old building layout problems become more complicated and machinery may have to be completely rearranged to fit the existing conditions.

10. Restrictions of Supervison.—Where a superintendent or general foreman is placed in charge of several similar or related departments, these departments must be located near one another so that he may be able effectively to superintend them. If the departments are scattered, the time of the superintendent would be lost going from department to department, and the foreman would have difficulty oftentimes in finding him when questions came up for his immediate attention.

11. Restrictions of the Plant Site.—It is desirable to lay out a plant with its main axis east and west so that the light will be secured from north and south windows. When the shape or other restrictions of the plant site do not permit of such a layout, then those departments that require a north light will have to be placed in a wing receiving north light, or some other arrangement made to overcome the difficulty. Other restrictions may be due to the lay of the land and the character of adjacent buildings. One large

industrial concern took advantage of a very decided slope of the land from the street level to the railroad at the rear, by putting their receiving and shipping rooms on a level with the railroad ten feet below the street level. This permits the use of the basement space for storage of raw materials and finished goods and avoids expensive grading.

12. Provision for Future Expansion.—Many concerns in planning an industrial plant do not make sufficient allowances for growth, with the result that when the growth of the business necessitates expansion the original building is thrown out of balance by the additions, and the entire machinery and departments have to be rearranged. Such a condition may be guarded against by having

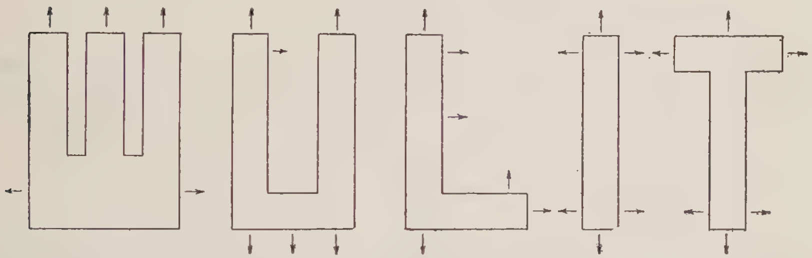


Figure 14. Ground Plans of Factory Buildings Indicating Possible Directions of Expansion

the original plans designed with a view to future expansion. As all departments ordinarily do not expand equally, fast-growing departments should be placed where additional space will be available and where their expansion will not materially disturb the work of other departments.

Two methods may be used in planning for expansion.

(a) Build a larger plant than is necessary and rent the portion not needed. In such case the lease given should be for such a term of years that it will expire at approximately the time when expansion is expected to be needed. This method is not always a desirable one as it requires more initial capital than would otherwise be needed, and as the assurance of a suitable tenant cannot always be relied upon.

(b) Plan and construct the buildings to meet present needs but suitable for future expansion. In a multi-story building the founda-

tions and walls should be made heavy enough to permit of adding one or more floors at a later date. Or the plan of the building may be such that extensions may be added at the ends or sides without disturbing the system. Figure 14 shows several ground plans, the arrows indicating some of the possible directions of expansion.

Making the Layout.—Even with detailed knowledge at hand of the processes and the sequence of operations, of the machines needed to attain the given production, of the order in which it is desired that they should be laid out and of all the other influencing factors, plans rarely go smoothly and shifts continually have to be made until the best layout under existing conditions is reached. It is advisable, therefore, not to make blueprints of the layout until all difficulties have been ironed out, as otherwise considerable time and effort will be wasted in drafting work.

With an accurate floor plan drawn to scale, and with small cardboard templates cut to the same scale and representing the floor space required by each machine or workplace, changes may be readily made. Everything that could possibly affect the placing of the machines should be shown.

Figure 11 shows the general plan of layout of an entire automobile plant. Figure 12 gives the general layout of the turret lathe shop of a machine tool plant showing the flow of work and the relative position of departments within a shop. Figure 13 gives a detailed layout of these departments showing the relative positions of machines, workplaces and storage places. This layout was determined with the aid of templates cut to scale.

CHAPTER VII

ANALYSIS OF THE INDUSTRIAL PROBLEM (Continued)

Heating and Ventilating.—Efficient operation of a plant requires that there be at all times an adequate supply of pure air of the proper temperature and degree of humidity. The expense of installing and operating a suitable heating and ventilating system is more than offset by the increased efficiency of the workers, the elimination of a great deal of lost time due to illness, and a reduction in labor turnover due to the attraction of the right sort of workers to a plant maintaining proper working conditions.

To appreciate the importance of proper heating and ventilating one has only to visit a modern plant equipped with adequate equipment and devices for insuring a plentiful supply of properly tempered pure air and to contrast the conditions there with those found in any of the old type of factories where heating arrangements are most ineffectual and where the only change of air is by the occasional opening of windows or doors. The workers in the stale, heavy, germ-laden air of the old factory are invariably listless in their movements and frequently sullen and irritated, those near the windows objecting to the draught and those further removed from the windows complaining of the lack of fresh air. There is no logical excuse for such conditions, as heating and ventilating are subjects to which much attention has been given by industrial engineers. Systems affording proper and uniform distribution of heat and excellent ventilation can be installed at a comparative low first cost and low maintenance expense, so that it is folly to curtail expense in this direction when it has such an important effect on production.

Temperature and Humidity.—The proper temperature to be maintained in an industrial plant depends upon the nature of the work and the humidity. The less the humidity, the higher the temperature required. In the winter months when the usual factory steam heating system is used the process takes the moisture from the

air, and unless a sufficient amount of moisture is introduced, the air becomes exceedingly dry and enervating and irritating to the membranes of the nose and throat. Such air conditions affect not only the workers, but frequently the product as well. In a textile mill it is especially important that the air be moist. If the air is dry it is difficult to work the fibres, they cannot be twisted as tightly as they should be, with the result that the product is not satisfactory.

Where the nature of the work requires considerable activity on the part of the workers the temperature should be lower than in the case of an office, or other sedentary work. The temperature in a foundry, for example, should be from 50 to 60 degrees, while for comfort and efficiency an office should have a temperature maintained at 68 to 70 degrees.

Heating and Ventilating Systems.—Heating and ventilating are subjects which should be considered together. Buildings should be well ventilated and at the same time should be adequately heated in the winter months. This thought should constantly be borne in mind in determining the heating system to use. Where there are but a few operators, handling clean, odorless material the question of ventilation is a simple one, but where there are a hundred or more operators assembled in one room, as in a shoe factory, a clothing factory and many others, or where considerable quantities of dust, smoke or gases are given off during the manufacturing process, the question becomes a more serious one and one which in many cases must be solved in accordance with state statutes. The type of heating system, therefore, depends upon the particular class of work done and the size, type and construction of buildings. A heating system that would work very well for one plant might prove totally unsatisfactory for another plant. The heating problem of an ordinary machine shop, for example, may be readily solved by a steam heating system using radiators placed along the outside walls. In a dye house, however, where quantities of steam are given off from the boiling, dyeing and washing vats provision should be made for taking up this steam by a circulation of warm, dry air; otherwise the air would be heavy with clouds of steam, and there would be constant drip from the condensed steam or moisture.

Heating systems may be roughly divided into direct and indirect heating systems.

1. Direct Heating System.—The most commonly used heating system is the direct system utilizing steam. Where a plant generates its own power steam may be taken from the power boilers and reduced to the pressure required in the heating system, or exhaust steam from the engine or turbine may be utilized. Where power is purchased a separate heating boiler must be installed. Steam coils and radiators are then placed on the outside walls of the rooms to be heated, the number, size and extent depending upon the radiating surface required.

A hot water system may be used for industrial heating, but it is hardly recommended, since while it has the advantage of maintaining a more even temperature with less attention than steam heating requires, it is more costly to install, requires a greater amount of radiating surface, takes longer to heat the building to the required temperature, and is accompanied by the risk of pipes freezing and bursting should the building become cold.

2. Indirect Heating System.—With the direct heating system the radiators and pipes ordinarily are placed along the outside walls; the hot air rises, cools rapidly as it comes in contact with the walls and windows and finally rests as a layer of warm air next to the ceiling. Thus the floors may be cold while directly under the ceiling or roof the air may be hot. Likewise, valuable space near the windows is taken up with radiators and pipes when it could be utilized very profitably as work spaces for operations requiring a good supply of natural light. To overcome these disadvantages the indirect heating system is used. The indirect system, commonly spoken of as the blower system, consists of a heater composed of pipes, tubes or cast iron sections through which are passed live steam or engine exhaust, and a fan either electrically or engine driven to circulate the air, drawing or forcing it through the heating units and distributing it through ducts to the rooms to be heated, the outlets being located at the points desired. The air used may be drawn entirely from out-of-doors, as in the case of crowded plants or where disagreeable odors or fumes are given off during the process of manufacture, or, as in very large shops where there are no objectionable air conditions, it may be satisfactory to reuse the old air which has already been heated, thereby taking less heat to raise it to the desired temperature. In the average case part of the air

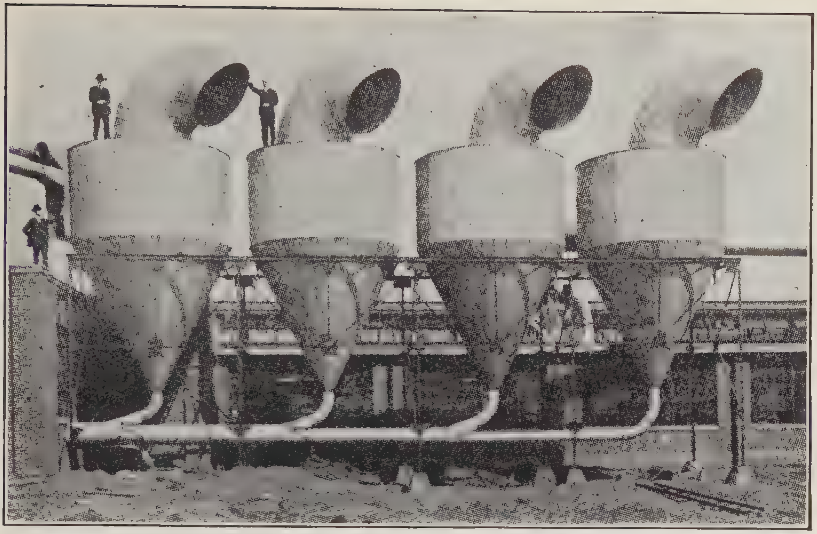
will be drawn from the outside and the balance taken from the building. In this way by varying the percentages used, as many complete air changes per hour can be made as are necessary. By drawing the air through a water spray or washer, not only may the heating and ventilating be controlled, but the humidity as well. According to circumstances the washer may be so modified that the air will be given greater or less humidity, as any desired standard is wanted for the various factory processes for which humidity or dryness is required. This not only has an important effect upon the product but the worker as well. In summer by using cold water in the heater and running the fan the oppressiveness of sultry weather is relieved and the change in the air is very noticeable.

Special Air-Conditioning Problems.—Dusty trades are responsible for a large number of deaths resulting from tuberculosis.

(Courtesy of Kirk & Blum Mfg. Co., Cincinnati, Ohio)

Figure 15. Exhaust System for Collecting Metal Dust

Grinding, polishing and buffing, important operations in nearly every metal working plant, expose the workers to bad air conditions unless an effective dust collecting system is used. Figure 15 shows a section of the Oldsmobile radiator buffing department illustrating an effective buffing department piping system. By the use of such a system the plant is kept clean, the worker's health and comfort are protected, and the motor bearings and other working parts of the

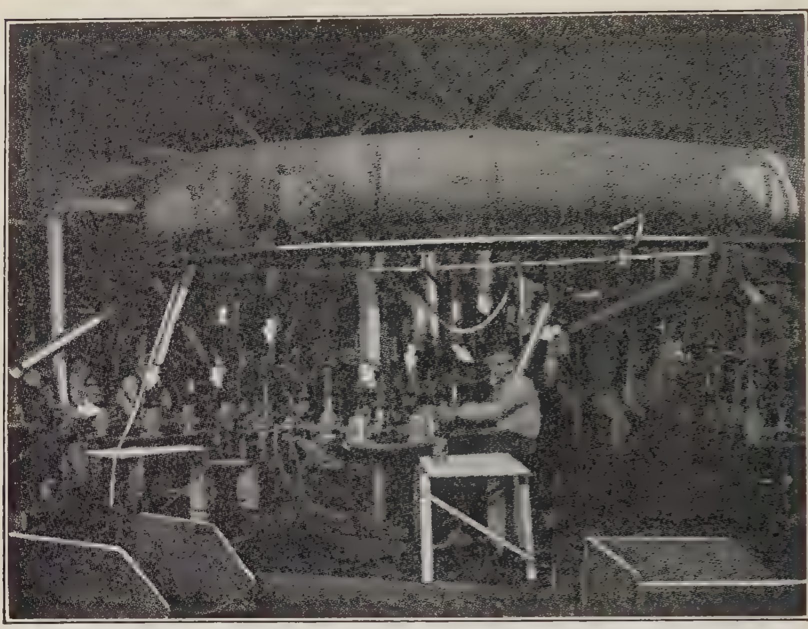


(Courtesy of Kirk & Blum Mfg. Co.)

Figure 16. Blower System for the Removal of Dust and Shavings from a Woodworking Machine

(Courtesy of Kirk & Blum Mfg. Co.)

Figure 17. Wood, Dust and Shavings Being Collected and Fed to Fires—a Part of the Blower System Shown in Figure 16



(Courtesy of American Blower Co., Detroit)

Figure 18. Cool Air Ducts for Men and Molds in the Glass Plant, Turner Bros., Terre Haute, Ind.

(Courtesy of Kirk & Blum Mfg. Co.)

Figure 19. The problems of fume and gas removal are so varied that practically every installation is necessarily different and requires engineering ingenuity and experience to meet the requirements effectively. This illustration shows a few of the hoods and connections in the chemical department of the Ford Motor Co.

equipment are protected from excessive wear. In the case of nickel, silver and other valuable metals, the reclamation of the dust proves highly profitable.

In woodworking plants, especially on large-scale production, the effective operation of a blower system for the removal of dust and shavings is an absolute essential as a clogged blower system stops production. The blower system must, therefore, be designed and installed for dependable, uninterrupted, full capacity operation.

Figures 16 and 17 give an idea of the system used at the Globe Wernicke Co. The installation includes 11 fans and 5 dust collectors of large capacity removing shavings from 135 woodworking machines. The shavings are conveyed a distance of 800 feet from the machines to the boiler house, being delivered first to the four collectors shown in Figure 16, then being blown to the collector on the roof of the boiler house which feeds the shavings directly on the fire through the top of Dutch ovens, as shown in Figure 17. Every day this system handles 48 tons of refuse.

Blower systems are used in glass plants to supply cool air to the operators and to the molds. Figure 18 shows an installation used to relieve the intense heat at the glass plant of the Turner Bros., Terre Haute, Ind.

Other installations of blower systems are used for removing hot gases from heat treating departments; smoke from enameling ovens; absorbing vapor in paper mills, packing houses, etc.; collecting and conveying scrap paper, cotton and wool; for collecting lint and dust in textile and hosiery mills and tire and rubber plants; for removing waste; reclaiming valuable materials; drying paper, leather, etc., and a dozen and one other uses. This very diversity of application shows the advisability of manufacturers' studying their various industrial problems to see whether a blower system properly devised and installed would not economically and efficiently solve many of their problems for them. (See Figure 19.)

Industrial Lighting.—In the discussion of the planning of the layout of an industrial plant it was brought out that those processes requiring an unusual amount of light should be placed nearest the windows, or preferably in a single-story building with a saw-tooth roof, or on the top floor of a multi-story building where skylights or a roof composed mostly of glass may be used. This is because

daylight is superior to any form of artificial light. As the intensity of daylight, however, varies depending upon the season, weather conditions and the time of day, daylight lighting must be supplemented by artificial lighting.

Skylights and Windows.—Daylight illumination may be secured through the ordinary skylight in the roof that we are all familiar with, or through a saw-tooth roof which is nothing more than a series of parallel glass arranged at such an angle that it receives no direct rays of the sun. Saw-tooth roofs permit of nearly uniform illumination over the entire floor space and are of special value in lighting large rooms where natural lighting through side windows would be ineffective for many of the operations placed at distances exceeding 20 feet from the windows.

The provision for adequate natural lighting has been one of the prime factors in the development of the modern factory building. The modern "daylight" factory has in some cases a ratio of window space to floor space as high as 1 to 3. It has been found that a more even distribution of light may be obtained through the use of some of the standard forms of prismatic glass in place of ordinary window glass. The surface of prism glass has hundreds of minute prisms, their size and shape having been scientifically determined to promote a maximum diffusion of light. It has been recommended by the American Standard Lighting Code that the use of prismatic glass be confined to the upper sash of windows. Prismatic glass in the lower sash is likely to give the worker a feeling of being shut in which is very objectionable to some persons.

A matter which would hardly seem to merit being spoken of is that of the necessity for frequent cleaning of windows. This would seem to be a self-evident and generally recognized fact. In noticing the condition of factory windows, however, one is struck by the fact that one rarely sees any that are really clean. A great deal of available daylight is lost and plant efficiency lowered due to the film of dust and dirt. This waste could be readily eliminated at a very low cost if the necessary facilities for doing the work were provided.

Color of Ceilings and Walls.—The use of a light-colored paint on the walls and ceilings to reflect light is a big factor in efficient lighting. The reflecting power of colors varies, white walls re-

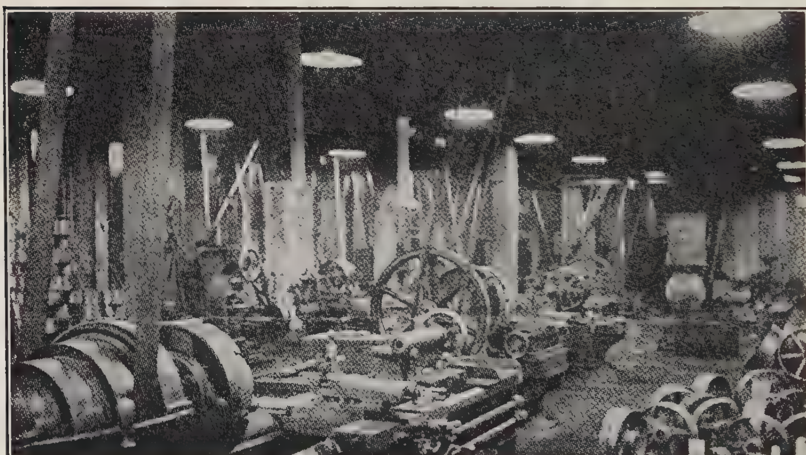
flecting as high as from 80% to 90%, light green from 57% to 75%, while dark green reflects only from 10% to 25%. A plant with the upper walls and ceiling of white and the lower side walls and machinery painted a soft gray or other neutral color presents not only a neat, well-kept and pleasing appearance, but in addition adds to the efficiency of the workers and at the same time reduces the lighting bills.

Artificial Illumination.—In using artificial illumination the common error is not in supplying an inadequate amount of light but rather the imperfect diffusion of light with excessive brightness and contrasting deep shadows, thus causing eye-strain with resultant fatigue. Frequently, by retaining the present equipment and correcting improper direction and elevation of light a marked increase is noted in production efficiency and a decided decrease in material wastage and in the number of accidents. Gloom as well as unshaded lamps close to the eyes and in the direct line of the worker's vision which cause a momentary blindness have been the direct cause of many industrial accidents.

The lighting requirements of industrial plants vary greatly due to the variations in the nature and class of work performed. Frequently, in the same plant different departments will require different degrees of illumination. In a leather manufacturing plant the finishing department will require twice the intensity of illumination required in the tanning department. Likewise, in an office the drafting room will require twice the illumination required for general office work and four times the amount required for hallways. The adequacy of illumination cannot be rightly judged by the eye, because after one has been in a room for a short time the eye becomes accustomed to the light of that room. The only safe way is to measure the illumination by a foot-candle meter which tells exactly how much light there is and then compare the results found with the quantities required as given in the tables of intensity published by some of the national illuminating associations. While various influencing factors may cause slight variations from the standards given in the tables, any marked differences should call for immediate attention and correction as the standards set represent what best current practice has found most effective.

(Courtesy of The Society for Electrical Development, Inc.)

Figure 20. Illustration of Poor Lighting



(Courtesy of The Society for Electrical Development, Inc.)

Figure 21. Same Shop as Shown in Figure 20 But Well-Diffused Illumination Everywhere

The National Lamp Works of the General Electric Company suggests that the answers given to the following questions will give a fairly accurate check on the efficiency of a plant lighting system:

Are there any bare lamps?
Bare lamps are wasters of light. They cause glare and eye-strain and should not be tolerated.

Are old-fashioned drop cords used?
Drop cords are lamp breakers. Lamp cords are liable to be caught in belts, gears, or entangled in shafting or pulleys. They have no place in a modern lighting system.

Are units too far apart?
Units placed too far apart cause "spotty" lighting—bright under the lamps, with dark spaces between. In most factories, probably in yours, good results can be obtained if the units are not more than 10 feet apart, and equipped with suitable reflectors.

Are clear lamps used in open shades?
Clear lamps should not be used with shades or reflectors open at the bottom. Replace with bowl-enameled lamps.

Are the lamps too small?
Are any of the lamps used for general overhead illumination less than the 200 watt size? You can get good lighting with smaller units, but the cost for installation, reflectors, lamps and current would be excessive.

Are there sharp black shadows?
Your hand, held over a white piece of paper on bench or machine should cast only a faint, hazy shadow. Shadows are the cause of many accidents.

Is the shop gloomy and cheerless?
The fundamental thing is to have plenty of light everywhere. Nothing contributes more to contentment and satisfaction of workmen than a cheerful workplace.

Are shades and lamps dirty?
Dirt on reflectors and lamps is responsible for a loss of as much as 40% to 60% of the light you pay for. A regular monthly cleaning schedule is a most profitable bit of shop systematizing.

Are there any dead lamps or empty sockets?

The value of even the most carefully planned lighting system can be nullified by dead lamps and empty sockets.

Figure 20 is an illustration of poor lighting with glare from wrongly shaded lamps and gloom from too little light—two big factors in plant inefficiency. Figure 21 shows well-diffused illumination everywhere. Lighting units are at proper height, properly spaced and direct view of the filament is cut off by wide, deep reflection.

Available Expert Advice.—Local lighting companies place at the disposal of plant executives lighting experts to help solve factory lighting problems. John Magee, president of the Detroit Piston Ring Company, in an article written for *Factory,* February, 1923, told in a most interesting manner how changes in their lighting system put in by the local light and power company resulted in an increase in production of 25%. The following is an extract from that article:

To determine the exact value of lighting we made an unusually thorough test extending over a period of fifteen months keeping machinery, number of employees and every other factor as nearly fixed as possible. At the time when our tests were conducted we were running at about 70% capacity, based on the production of 12,000 piston rings per day. As near as could be determined the average intensity of illumination with the old lighting was 1.2 foot-candles.

We took one department—25 feet by 100 feet, and provided it with 35 outlets spaced on 7½-foot centers. These outlets were mounted 9½ feet from the floor, and the whole system was so arranged that any size lamp up to 200 watts could be used.

Lamps with diffusing caps rated at 100 watts were first tried over a period of four months. The average production during that time was a little over 13% better than the old individual type of lamps. And the average intensity of light for the whole shop was about 6½ foot-candles.

And so it went: 150 watt lamps with standard dome reflectors pulled a production of 88.4% or an increase of 17.9% over the old installation; 200 watt lamps with dome glass top reflectors showed a 96.3% production which was actually a 25.8% increase. The intensity averages for these last two tests were 9 foot-candles and 14 foot-candles, respectively.

We analyzed the results as we went along, but before we were half through with the job it was perfectly obvious that there was going to be a neat little saving here. So we laid aside the figures for an instant and started estimating in another direction.

Like all companies, we had a certain amount of spoilage, accident hazards, and so forth, which, no doubt, could be laid to inadequate lighting. A few minutes spent in adding and subtracting revealed this fact; that the costs of all the spoilage, accident hazards, and so on, which represented wastes, could be offset by 1% increase in production. And the 200 watt installation gave us a 25% increase!

While the increased cost of the new lighting over the old was 48%, this only represented about a 2% increase measured in terms of the monthly payroll.

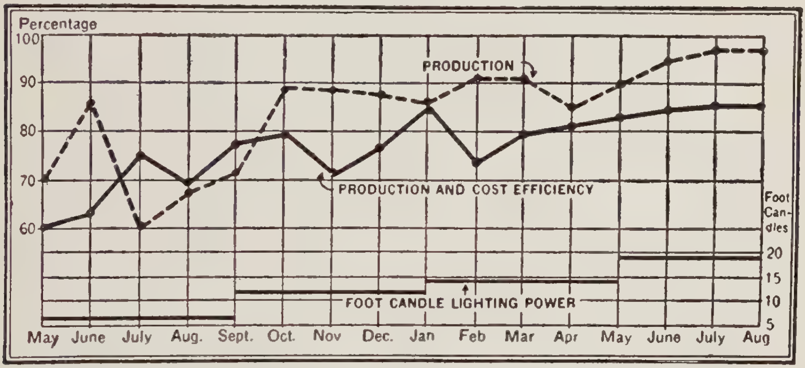


Figure 22. How Production Increased with Improved Lighting in the Detroit Piston Ring Company. The line in steps shows how illumination was increased. Note that production improved to practically 100%, and efficiency rose from 60% to nearly 90%

In other words, the maintaining of a good lighting system is but a small fraction of the general operating expenses. And because it has such an important effect on production, it is folly to think of curtailing its expense.

Because of the marked decrease in overhead expense, we would get our costs down to a point where we could sell at a figure which brought an increased volume. And this volume is a factor which still further reduces overhead. Improved lighting was an eye-opener to the many savings better methods of management can make. And we are becoming increasingly aware of these better methods every day.

Power Requirements.—The question of power is always an important one. However, as this subject is discussed to some extent in Chapter VIII and taken up in detail in Chapter XXI, no space will be devoted to it here.

CHAPTER VIII

ANALYSIS OF THE INDUSTRIAL PROBLEM (CONTINUED)

Labor, Supervision and Management Required.—Throughout the analysis, continual stress has been placed upon the influence of the treatment of the various factors upon the workers. It was emphasized that if the work is to be done satisfactorily and the workers are to be permanent, there must be pleasant, healthful working conditions. Such emphasis can hardly be overdone, for if any one element can be considered the most important element in industry, all elements being so interrelated and dependent upon one another, then it is the human element which predominates. It has been the lack of sufficient attention to this element in the past that has given agitators and trouble-makers the material to work with, and has put labor into a receptive state of mind for destructive propaganda.

In the past, in starting a new industrial enterprise, or in expanding a present one, a working force was gathered together drawing the workers and supervisors from similar industries and the then unemployed, and expecting by some unseen and miraculous force that the men would instantly adapt themselves to the new conditions and work as a harmonious whole. There are many obstacles, however, that stand in the way: first, the previous experiences of the men, each having different ideas of methods of work, due to the varied methods used in the plants where they were formerly employed; again, to the difference in working conditions from those which the men have previously known, the difference in company policies and in the fitness of the individual for the particular job. This latter item is at last beginning to be given a little of the attention it merits.

In the modern industrial concern, the human element requirements are now studied and defined, and each job analyzed to see just what qualifications are needed in order to properly match the man and the job. It is now pretty generally realized that a man may be most excellent in one branch of a line of work and yet be a failure in another branch. An oil and grease manufacturing concern re-

quired the services of a sales manager. They employed a man who had had marked success in selling office equipment. The result was a total failure with subsequent loss to the salesman, the office equipment concern and the oil and grease concern. The salesman gave up a good position to take another which he could not hold, the office equipment concern lost a star salesman, and the oil and grease concern lost through a disrupted selling organization, through the loss of a number of important customers and of innumerable prospective customers, and through a big reduction in total sales with its consequent effect on production and company finances. They found, at a considerable cost to themselves, that a star salesman does not necessarily have the qualifications for making a sales manager, especially when his sales experience has been with a different line of goods. If they had analyzed their requirements for the position of sales manager and had specified the qualifications necessary, they would never have chosen as they did. This may seem a rather extreme case of poor selection, but, unfortunately, it is quite typical of what has been done in hundreds of cases in the past, and of what is still happening in some concerns today. The making of a job analysis and the setting of job specifications will be taken up under Chapter XVIII.

Labor Required

The nature of the labor, whether skilled or unskilled, depends upon the product to be made and the manufacturing processes. A different type and temperament of person would be called for to do work where strength and little skill are needed, than on delicate or small light work where accuracy or speed may be the all-essential requirement. It would be at once evident that labor requirements in a foundry would be very different from those in a watch factory or a factory manufacturing precision instruments. After the general nature of the labor has been decided upon, the requirements must be still further refined. The requirements of the several departments and even the divisions within a department must be analyzed. For example, a drafting department may require six draftsmen. This would seem to prescribe just what was needed until it was realized that some draftsmen do designing work very well, but are not so proficient at the mechanical part of drafting, while others can make

a very fine drawing but are poor designers. The proportion of drafting and designing work in this case would determine the actual requirement. The particular labor needs, therefore, should be thoroughly analyzed.

The probable number of employees required, both skilled and unskilled, the trades, and whether men or women, all must be determined. On light fast work, often women are better suited than men. The number of each kind of workers required in each department and the plant as a whole depends upon the nature of the work, the volume produced, the capacity of the machinery, the supervision and the extent of development and efficiency of the management. In one factory employing 100 workers with a supervisor to every 20 workers it was found that, by having a supervisor to every 12 workers, the same quantity and better quality of product could be turned out with 16 less men.

Supervision Required

It is very important that the right type of man be selected for all positions of a supervising nature. The supervisors come in direct contact with the workers, and their actions and attitude toward the men are taken as representative of the attitude of the management. Competent, fair-minded supervisors promote smooth running of a business. Inefficient supervisors, or those with the wrong temperament for the job breed dissatisfaction and discontent, and can nullify any personnel program and the best of intentions on the part of the management.

The supervision requirements vary with the kind of work and the class of workers supervised. The supervisor for a road gang, for example, must be of a forceful and persistent nature; he must be able to control his men and to drive them when necessary. On the other hand, the supervisor of inspection work in an industrial plant must have a totally different set of characteristics and a different temperament. To be supervisor in charge of inspection in some cases may involve considerable technical knowledge, as in the case of motors, of chemicals, or of highly specialized machinery. He must be thoroughly familiar with the standards set and with the use of testing machines, gages, measuring instruments, etc. In any case, the supervisor of inspection must be systematic, accurate and patient. His

function must be to teach his workers to be painstaking in their work, to put accuracy before speed. This requires a man of a patient and judicious nature, one who will guide rather than drive, and yet has the ability to get things done.

The supervision requirements should be carefully analyzed, as each of the several departments of the business may call for different characteristics in their supervisors. The various foremen in the operating division of an automobile concern must all be of a forceful and persistent type, men interested in getting the greatest amount of work of a specified quality accomplished in the easiest way, in the shortest time and at the lowest cost. Yet, even here there will be differences in the requirements for the various foremen. For example, the foreman of the shop in which crank-shafts, camshafts and piston pins are made where work on cylindrical grinders is held to very close limits, in the case of a piston pin to 0.0005 of an inch oversize and to 0.0000 undersize and where the taper must be not over 0.001 in 4 inches of length, must be a skilled mechanic, thoroughly familiar with the operation and adjustment of grinding machines and the set-up of the work. He must be precise and accurate and be able intelligently to instruct, direct and control his workers so that they will do their work with the greatest degree of accuracy, and yet turn out the specified quantity in the time allowed.

The foreman in the forge shop where the operation of a 5,000-pound steam hammer is an everyday occurrence calls for a different set of requirements. The work is often hot and disagreeable and yet calls for constant alertness and keen judgment on the part of every member of the crew. The foreman in such a case must thoroughly understand the operation of furnaces, how to forge and set up dies and all other necessary activities in a forge shop. He must have good physical strength and be able to endure heat, and, above all, he must have the quality of leadership, of controlling strong men and of getting work done willingly. In other words, he must be of the type that men look up to because he is a "good boss." All supervisors, however, must have in common a certain amount of managerial ability. They must be able to keep proper records, to make intelligent and accurate reports, to analyze properly, interpret and make intelligent use of reports given to them, and to carry out the company's policies.

Management Requirements

In deciding upon the management requirements one must bear in mind the three major elements in a business—financial, production and selling. Each must be adequately taken care of if the business is to be built upon a sound foundation, and then the work of all must be blended together into a well-balanced, smooth-working unit.

Financial Element.—Every step in the preparation for the starting of a new enterprise, every operation in manufacturing, every selling activity requires the expenditure of capital in one form or another. It is the lack of understanding and appreciation of the broadness of the financial element that has caused a multitude of new enterprises to become bankrupt and go out of existence. Likewise, expensive methods of financing have put a terrific handicap on many a business and kept it struggling along, whereas it would have flourished and paid big dividends if common sense methods of financing had been used. The management, therefore, should include someone in authority who understands the financial side of the business and can be depended upon to take care of this important element. He should be broad in his knowledge, yet conservative in his actions, as the efficiency with which a business uses its capital determines to a marked degree its success or failure. He must understand modern financing so as to be able to open up channels for securing the needed capital at advantageous terms; he must appreciate the value and necessity for financial control records, and he must encourage growth and development, but guard against unnecessary expenditure of the company's capital.

Selling Element.—Goods may be produced, but they are of little value if they cannot be sold. Every industrial organization requires the services of someone with the characteristics and temperament required for taking care of the selling element and who is at the same time familiar with the problems and cost of distribution. A new manufacturing concern turned out a very good product, but were unsuccessful in selling it. Fortunately, they came in contact with a commission agent handling a similar line of goods. He agreed to dispose of their product at a given percentage and a contract was so drawn covering a three-year period. Sales were very satisfactory, so much so that the concern was forced to expand. The two men

who control the plant are splendid production men, but have not the qualifications for the making of successful salesmen. Long before the expiration of the contract, they were complaining of the very sizable check that they had to pay the commission agent every month as his commission on sales, little realizing that if the check were not earned the sales would not have been made. They refused to renew their contract and then found themselves at a loss to dispose of their goods. Finally, fearing disaster with their enlarged plant and increased production and no ready market, they prevailed upon their former commission agent to become a part of the firm and take charge of the selling element. The concern has now grown to several times its original size, and is in fine, healthy condition, due in great part to the fact of its well-rounded organization with each element provided for.

The man in charge of sales must have a good personality, enthusiasm, initiative and perseverance. He must have the ability to sell. He must have faith in himself, in his company and in the product. He must sell himself and the product to his salesmen before he can hope to develop a good sales organization to sell for him. An exceptionally good sales manager was made a very tempting offer by another concern. He accepted, but after being with the new concern a short time and studying the product, he found he could not fully believe in it. With much hard work he succeeded in building up quite a strong sales organization, put on a splendid advertising campaign and, in general, got the machinery of selling working well so that a successor could carry it on, and then resigned. He was too conscientious to sell something he could not fully believe in, and yet at the same time he wanted to do his full part by his employer who was a very fine man with an unusually strong belief in his product. As the sales manager expressed it several years later after the company had failed, "What a relief it was to get out. I wanted to build up the department as I had promised to. Mr. —— was such a fine fellow to work for, and believed in the product so strongly that I felt I must be wrong, but I had to resign before my lack of faith would be felt by the sales organization."

The man in charge of the selling end of the business must work in close cooperation with the head of the financial and production elements so that sales schedules will coordinate with schedules of production and with financial requirements and plans. He must, there-

fore, be a man who is broad in his viewpoint, seeing his work from the light of the good of the whole concern, rather than from the narrower field of sales alone.

Production Element.—The management requirements for the production element are very different from those of the selling element. The production manager is interested in the problems of labor, in the efficiency of the plant, and in any improved methods or new equipment which will increase that efficiency. He is concerned with getting out the product and his aim is to speed up production, to turn out the greatest possible amount of work at the lowest cost, in the shortest possible time, and yet maintain the required quality. The man to fill such a position must fully understand the process of manufacturing; he must be familiar with the machines and equipment to be used; he must be progressive, always on the alert for improvements that can be made; and yet he must have stability, so as not to be carried away by every new theory that comes out or by the smooth talking of equipment salesmen. Above all, the production element requires a leader, one who has ability in the art of handling men, in organizing and in getting work done.

Management Required for Centralized Control.—After the management requirements for the financial, selling and production elements have been settled upon, there must be some way provided to blend the management of the three into a balanced, cooperative working unit. For control and coordinating purpose, therefore, there should be an executive upon whom responsibility for the operation of the concern is centered, and with and under whom the financial, selling and operating management works. For such a position is required a man of all-round administrative knowledge and ability, who will recognize the relative importance of each element of management in his particular business and will govern his decisions accordingly.

As practically all men come up through the ranks of one, or at the most two of the three channels—finance, sales and production—it is extremely difficult to find a man who has equal knowledge and ability in all three lines. It is only natural that an executive would be more fully versed in and rather partial to the field in which he has developed.

The requirements for the chief executive, therefore, must be very

carefully studied, to see not only which element should predominate but the comparative value of each element in the particular concern. Care must be used that the manager selected be not so strictly a certain type as to be one-sided and not appreciate the importance of other elements of management, as all elements enter to a certain degree in every enterprise.

The following are some of the main disadvantages of pure types:

Financial Type. The financial type of manager is inclined to be overconservative. He considers each problem mainly from the standpoint of the amount of capital required, keeping down inventories and expenditures for equipment, labor, sales drives and other necessary outlays, until he goes past the point of economy and becomes a drag on the business.

Sales Type. The sales type is diametrically opposite to the financial type. He considers volume of sales as the all-important factor, and is liable to ignore costs, to carry unnecessarily large inventories of finished stock and to play havoc with the production end of the business for so-called sales policies.

Production Type. The production type of manager is a good organizer and manager of the production end of the business. He is interested in the human element, in costs, in large volume of production and high efficiency, but is likely to tie up too much money in inventories, new machinery and equipment. He is apt to consider all problems from the standpoint of production requirements, rather than the necessities of the trade.

The Ideal Type. The ideal type of chief executive is the manager of broad vision, with a sound working knowledge of all three channels and an impartial attitude toward all of them—one with a wholesome respect for every branch of the business, with the ability to rate the relative importance of every department, and to direct and control the organization accordingly.

Location

Importance of a Wise Choice.—In our analysis of the industrial problem the consideration of the factory location has been left to the last, so as to emphasize the fact that in starting any industrial concern a thorough analysis should be made and all requirements definitely known before the location is finally settled upon. Mistakes

in location are permanent ones; a building once built cannot be moved, and while there are cases where individual concerns have given up a poor location or one that they have outgrown, and relocated at a more favorable one, such changes are uncommon and would only be recommended in extreme cases. Relocation is a costly undertaking, and not by any means always a certain one. It is frequently very difficult to dispose of the old plant at anything like the price which would have to be paid for the new plant; changes will invariably have to be made in the personnel, tearing down, transporting and setting up machinery and equipment again is costly, requiring the services of experts in that line, and even then, adjustments and changes here and there would have to be made, as difficulties are brought to light when the new plant is put in active operation.

Even with enough stock produced in advance to meet estimated requirements during the period of relocation there are bound to be delays in meeting customers' orders, as plans rarely can be carried out as smoothly as is expected. Even old customers are not always willing to stand for delay and may, at least for the time being, give their orders to a competitor. This gives the competitor a "toehold," which is to be guarded against, as it may develop into a strong foothold and result in the loss of the customer's business. The above is not given as an argument against relocation, as relocation at a strategic point has been the means of saving a number of plants that were fast losing out, but it is given to show the difficulties encountered through lack of sufficient attention at the outset to proper location, and to the need for thorough analysis of all influencing factors, rather than to be governed by personal prejudice and convenience and by impatience to get the plant started.

One point to be borne in mind in considering the subject of location is its importance to small concerns. One is very apt to consider the study of the subject of location as being applicable to only the large corporations. It is true that the large corporations are awake to the importance of location at strategic points, and that in locating a plant they almost invariably employ experts to investigate various localities and to choose the one best meeting their specific requirements. A thorough investigation and analysis of conditions and needs, however, is just as important, if not even more so, for the smaller concern. The very establishment of a large plant at a given location will attract labor and capital, its very size and complete-

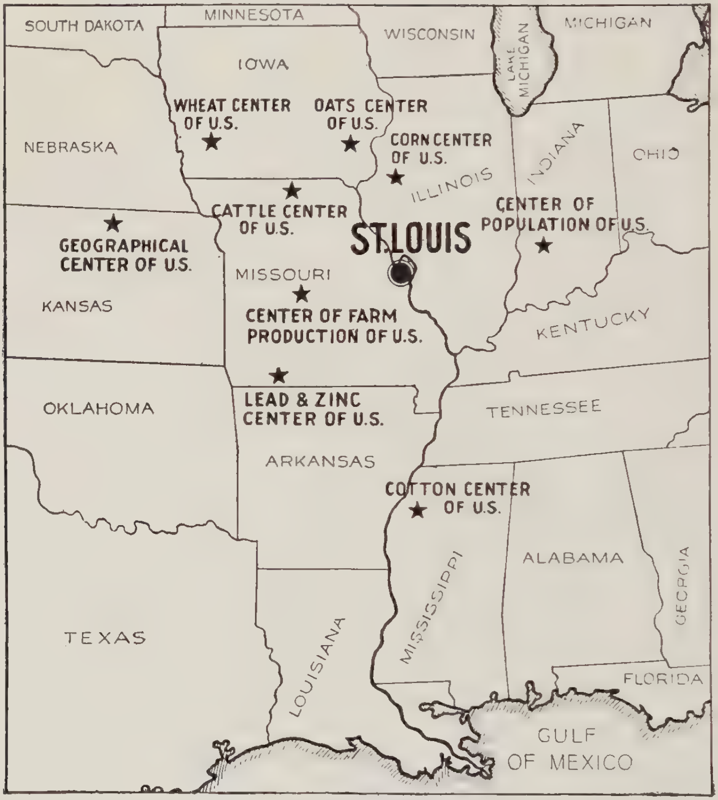
ness tend to make it self-sufficient, while the smaller concern does not have any perceptible amount of drawing power and is dependent upon various outside services, as it has neither the need nor the facilities for supporting service departments of its own. It must therefore, locate where capital and labor are available, and where there are located concerns offering the services it requires.

Factors Influencing Location.—The geographical location and the particular site should be selected with the view to attaining as nearly as possible the ideal location for the particular enterprise. Of several locations from which selection is to be made, each will probably possess certain requisites and fail to comply with the requirements in other particulars. In order to come to the most accurate conclusion, it is well to tabulate all requirements, giving each due weight, and to check each location against the weighted list. This method will permit of ready elimination of undesirable locations and of final decision upon the one which most nearly approximates the ideal location for that enterprise. The weight to be given the factors influencing location will vary with the particular enterprise, factors which are of significance in one instance being of relative little importance in others.

Raw Materials.—In many cases, the location will be best which will put the plant at or near the source of raw materials. This is of special importance to concerns using raw materials that are perishable, and to those whose raw materials are bulky and heavy and the greater part becomes waste during the process of manufacture. Nearness to the source of raw materials serves many purposes: first, it eliminates the danger of holding up production due to lack of available material; second, it reduces the amount of capital tied up in inventory (when at a considerable distance from the source of raw materials, a plant must carry a sufficient reserve stock to allow for any irregularity of supply); and third, it reduces the raw material transportation costs, sometimes a big item in the final cost of the completed product.

Figure 23 shows the advantages St. Louis, as an industrial community, derives from being geographically located near the center of some of the basic material sources. It would be at once apparent that, other factors being equal, it would be poor business to pay the heavy transportation rates on these raw materials to the industrial

centers in the east when location is available near the source of supply. Such heavy transportation costs would materially increase the cost of the finished product and decrease the ultimate profit, especially if the concern had to meet competition from concerns more favorably located. Sales prices are governed to a marked degree by the price



(Courtesy of Chamber of Commerce, St. Louis)

Figure 23. Location of St. Louis in Regard to the Center of Some Basic Raw Material Sources

at which competitors offer their goods. The concern with the lowest manufacturing cost, therefore, reaps the greater profit and can undersell and take the business from his competitors.

Nearness to Customer's Market.—Products are useless to the manufacturer unless they can be marketed. The ease and cost of

transportation to the customer is a big factor in many cases, especially in those industries calling for quick deliveries or special order work. In such cases, the plant should locate near the market it serves. Likewise in industries where the finished product is greater in bulk than the raw materials entering into it, or has a marked increase in value or in the care with which it must be handled. In some instances, the various units that enter into the finished product are made in a main central plant and then shipped to smaller assembly plants, each located near the market it is to serve. This materially reduces the transportation costs, as units can be packed more compactly, and as they come under a lower freight classification. The Ford Motor Company is a well-known example of such a plan of location.

Labor Supply.—The factor of labor supply in the question of suitable location centers mainly around the available supply of skilled labor. As like artisans are inclined to congregate, this has served to restrict certain industries to certain sections of the country and has made it difficult for a concern in that industry to locate out of that section, even when other factors of location are decidedly against that location. The original location of industries in this country was in many cases due purely to chance; the first business in a line prospered in a particular location, so others followed, and an industrial community resulted. With the rapid development of the country, economic conditions change, and in some cases industries are forced to migrate to meet that change. The most difficult factor in such migration is the unwillingness of labor to move from the section they are accustomed to. The pioneers in industrial migration are very likely to have "hard sledding" in securing and holding competent labor. This factor must be given due weight in deciding upon the suitability of a location.

Another item to be considered under the factor of labor supply is the dependability of those available. An industrial center that has comparative freedom from labor unrest has a very big point in its favor. A location where the majority of houses are occupied by their owners indicates a steady and dependable class of people.

Supply of Power.—Industries in which the manufacturing process requires a considerable amount of power frequently find the

supply of power the paramount factor in location. Niagara Falls and vicinity owes its industrial growth mainly to the abundance of power produced. It is the cheap power that has served to attract there the great abrasive and chemical plants, both industries consuming an enormous amount of power. Likewise, the New England states owe much of their manufacturing developments to their numerous waterfalls. Industrial communities strategically located in the Pacific northwest should likewise flourish, as the United States Geological Survey shows that the Pacific Northwest has more undeveloped water power within its boundaries than any other section of the country; in fact, it has nearly one-half the potential water power of the nation.

In considering the factor of available power supply, decision must first be made as to whether the plant should generate its own power, or purchase it from a public service corporation. If the price of fuel is unusually low, or there is a great deal of waste from the manufacturing process which may be used as fuel, then it would probably be of advantage to operate a small power plant. In many cases, however, it will be found that purchasing power is a more economical and efficient method; as power for industrial purposes is sold at a comparatively low rate, capital does not have to be invested in a power plant and equipment, and the trouble and expense of running the power plant is eliminated.

In locating an industrial plant which is to purchase its power, one must inquire into not only the cost of the power, but the continuity and reliability of service. For example, a concern locating in a section where there is a possibility of drought would want to know that the public utility corporation from which power was to be purchased maintained as a reserve a steam power plant operated with coal.

Ease of Financing.—The capital needed to finance a new enterprise is more readily obtained in a section where similar enterprises have already located and proved a success. The banks are familiar with the needs of the business and with the business practice in that industry, so do not hesitate to give a reasonable amount of financial assistance. Bankers and other business men hesitate to loan money on unfamiliar undertakings. Likewise, the rate at which money is loaned varies with the section of the country and the size of the industrial center. Loans which would be placed at 5% in one locality, might require 7% or even as high as 8% in another. Money is likely

to be easier in the East than in the West, and in large industrial centers rather than in the smaller towns.

Adequacy of Transportation.—The character of the business will determine the type of transportation used, and this in turn will have a decided bearing upon the question of location. Where the raw materials are heavy and bulky a location upon a waterway materially reduces transportation costs, as water freight rates are comparatively low. For rail transportation, location should be chosen, if possible, where there are competing railroads, as competition is apt to improve service and to lower freight rates. In some industries, like certain chemical industries where the raw materials have to be brought from isolated sections of the country, the classification rules and freight rates have a marked influence upon the success of the business, and a difference in freight rates between two localities may be the determining factor in location. Certain communities enjoy favorable commodity rates on certain products. This is an item worthy of careful investigation before definitely deciding upon a plant location.

Industrial Centers.—There are sound arguments both for and against locating in an industrial center preeminent in the particular line. The following advantages and disadvantages listed, most of which have been spoken of under the discussion of previous factors, are very apparent so need no further explanation.

Advantages:

1. Prestige to be gained. Limoges china is known the world over for its excellence. A concern newly located there to manufacture china would derive prestige from the fact that its trade-mark indicates that the china is made in Limoges.
2. Ease of financing is increased.
3. Greater variety and volume of raw materials offered. Suppliers of raw materials vie with each other in offering their best. In times of shortage of raw materials, the specialized industrial centers ordinarily are taken care of first.
4. More abundant supply of skilled labor. Skilled labor feels safer in a community where there are a number of like

industrial plants. A shut-down in one plant is not so serious as there are other possible employers.

5. The necessary service industries are attracted due to the volume of work in their line. Supply houses, repair shops, commercial laboratories, etc., establish themselves nearby. The individual plant has command of a large number of special services which it could not afford to maintain for itself.
6. Buyers are attracted. The periodic furniture expositions held at Grand Rapids, Michigan, and at Jamestown, New York, attract furniture buyers from all over the country.
7. Waste products are more profitably disposed of. Subsidiary industries establish themselves to utilize the waste and by-products when sufficient bulk is available to make the subsidiary industry a profitable one.
8. Transportation facilities are improved and costs lowered.

Disadvantages

1. Oversaturation of the market where the goods produced are of a perishable nature.
2. The industry may become handicapped by custom.
3. Labor difficulties in one plant are likely to spread to other plants, as labor in a specialized industrial center is apt to be highly unionized.

Climate.—In certain cases, as in the spinning and weaving of cotton, wool and silk, the need for suitable climatic conditions is an important factor. The location of the textile mills at Fall River and New Bedford, Massachusetts, was due, to a considerable extent, to the fact that the temperature there is less variable and the atmosphere more humid than in other sections. While today artificial automatically controlled humidifying systems can create a uniform humidity, the factor of stability of temperature remains an important item.

For the average plant, a climate that is temperate and is not subject to continued extremes of temperature will be found to be most satisfactory. Such a climate permits of outdoor activities on the part of employees for the greater part of the year, and is therefore very desirable. In addition, it reduces factory overhead where the heating of the plant is an item of consequence.

Local Restrictions and Inducements.—Tax rates and municipal ordinances merit careful consideration, as in some places tax rates are so high as to be almost prohibitive, and municipal ordinances are very restrictive. Other cities may offer special inducements for the location of industrial plants, such as free sites, tax exemptions, free power, subscriptions to stock, and so on. It is always well, however, to investigate carefully from all angles, as even with such inducements a location may not be as desirable as an established center which offers no such inducements.

Relative Advantages of City, Suburb and Country.—After it has been decided which section of the country best fits the needs of the concern for which the analysis is being made, the relative advantages and disadvantages of city, suburban and country locations must be weighed. These depend upon the size, type and financial resources of the particular concern. Roughly, it may be said that the city offers the greatest attraction to the small plant, the country to the large corporation, and the suburb to the medium-sized plant. On the surface, it would appear that the high price of land in the city would make it prohibitive to the small plant, but in reality the small concern can rarely afford to own its own plant even in the country, and the city offers loft buildings and specially designed factory buildings where a floor or two can be rented, whereas the country has no such accommodations. Then, too, the small plant has very little drawing power for labor, so must locate where the labor it requires is already available. All plants require various services; in the city these are available through service industries. In the country, the small plant would have to maintain its own services, which it could hardly afford to do. Cities likewise offer better transportation facilities, greater ease in financing and a bigger market, as the small plant ordinarily caters to local trade.

For the large plant, the city has fewer attractions and many disadvantages. The large concern wishes to own its own plant and to construct that plant so that it will be exactly suited to its manufacturing requirements. The high price of land, the scarcity of a suitable site, the high taxes and the restrictive ordinances put the city location out of consideration for the large plant. While labor is more plentiful in the city, the large plant has considerable drawing power, especially for the more desirable type of labor who want to enjoy the

more peaceful and healthful country life. Then, too, the cost of living is likely to be cheaper in the country. The employee has a possibility of owning his own home, and if conditions are made attractive for him he is more content. In the small country town, labor and management have the opportunity of meeting and knowing one another, and this to a great extent does away with the barrier of misunderstanding which is so apt to arise between management and labor when they do not have that opportunity. Labor disturbances, therefore, are likely to be less frequent in the country than in the congested city. The advantage of available service industries in the city is offset by the fact that the large plant has sufficient need and resources to care for that need, so that it can afford to maintain its own service departments. Likewise, the large plant is not dependent upon a local market as is the small plant. Again, by locating at a strategic point, the plant in the country can have the transportation facilities it needs, and in all probability at a lower cost than it could in a city location.

Location in a surburb combines many of the advantages of both city and country. Land and taxes, while higher than in the country, are considerably lower than in the city. Transportation facilities are usually good, and at least some of the more important service industries are ordinarily found there. Employees in many cases prefer to live in the suburbs, as they are then near enough to the city to enjoy its attractions, and yet are away from the congested conditions, higher rents and generally higher cost of living.

The Factory Site.—After the general location of the plant has been decided upon, a careful study should be made of the specific site. In any industrial section there are frequently several plant sites from which selection can be made. There are many considerations entering into the value of land for industrial purposes. In some instances, the cost of sites varies considerably according to their proximity to the waterfront, as in the Port Newark Terminal Development and others. Many industries locating along the sea coast think they require a waterfront location, whereas there are comparatively very few industries that have sufficient volume of incoming and outgoing shipments to warrant the expense of a waterfront location. Less expensive land some distance from the waterfront with facilities of a well-developed terminal railroad would prove just

as satisfactory in many cases and would greatly relieve the overhead burden.

The advantages to be derived from locating in one of the industrial developments such as the Bush Terminal, Brooklyn, and the Port Newark Terminal Developments are well worthy of consideration. Bush Terminal is actually an industrial city of itself. There are 16 model loft buildings, accommodating over 200 manufacturing and jobbing tenants, and 123 warehouses. There are 8 large piers in the Port of New York accommodating 25 steamships at one time, and there is trackage to every pier and every building. Transportation facilities of all kinds are available, so that shipments are economical and readily cared for, power is supplied upon a cooperative basis at a comparatively low cost, and many kinds of services cost the tenant but a fraction of what they would cost if he were not a part of the industrial community. Such advantages should be carefully reckoned in dollars and cents before decision is made to locate in a section without such advantages. The principle upon which the Bush Terminal is founded is to supply the manufacturers with every service that can be secured economically upon a cooperative basis. This spirit of cooperation should be made the keynote of all industrial centers, for it is bound to bring with it industrial well-being and to serve as an attraction to new industries.

Distance from Homes to Plant.—The factor of distance from employees' homes and the available transportation facilities for employees is a very important factor, especially where the workers are unskilled and work for a low wage. One concern which purchased what was apparently a fine piece of property at a low figure found, after building an expensive plant, that it was very inaccessible for its employees. The higher paid employees did not seem to object as they could come to work in their automobiles, but the lower paid employees preferred to work downtown nearer their homes, even at a lower wage. The consequence was that the concern has to pay a higher scale of wages than downtown concerns, and has to maintain bus service at their own expense, in order to secure the labor they need. This even in a few years has more than offset the original saving on the cost of land, and is an expense that will continue from year to year, as the plant is too far out to expect the town to grow out to it for years to come.

Workers begrudge the time they spend in going to and coming from work. It means more to them than the actual time spent; it means money spent on car fare or bus fare; it means perhaps an hour's less sleep in the morning, a hasty breakfast, a constant rush so as not to be late, a long ride or a tiresome walk home after a hard day's work, an hour more spent away from their homes and families. Workers will frequently pass up a job with better pay and take one less desirable in other ways but nearer home. Taken all in all, the convenience of the plant for the workers is one of the most important of all factors governing the selection of the plant site. The lack of convenience of some plants if figured in dollars and cents would be truly astonishing. Just from the standpoint of the lowering of efficiency on the part of the workers who have "gulped down a cup of coffee and ran," so as not to be late, an enormous industrial waste results, and the cost of this waste is all reckoned in the cost of the final product. The wise business man recognizes this fact and locates where it will be convenient for his workers and they will be able to come to work in a fresh condition ready to do a fair day's work.

Other Points in Choosing a Site.—There are a number of other points to be considered in choosing the site. First, there is the lay of the land and the suitability of the site for the building which it is proposed to erect. While some compromise may have to be made from the building as planned, still changes must not be such as will interfere with an efficient layout. The surroundings should be agreeable; there should be room for expansion; there should be facilities for sewerage disposal, water for drinking and manufacturing purposes, general drainage facilities. All of these and many other special features enter into the selection of the site. The cost of the site, including not only the purchase price but the cost of development, the probable increase in value, the cost of a railroad spur or siding, if on a waterfront the cost of a wharf or dock, all must be given due consideration. Of two sites, one may be cheaper in purchase price but actually more costly in the end, due to the amount of grading or the kind of foundation that will have to be used. All such points should be given due weight in the final analysis.

The foregoing discussion has been mainly from the standpoint of the concern that expects to buy a piece of ground and build.

Often, however, a new business may find it advisable to rent a building on a lease until it is more sure of its needs and until it has sufficient capital to expand. While owning its own plant gives a concern a feeling of satisfaction, this satisfaction is short-lived if the operation of the plant brings out unforeseen difficulties which can only be corrected at a big cost. Likewise, if the greater part of the capital is tied up in the grounds and buildings, the concern is likely to suffer from lack of necessary equipment and working capital. In such cases, it would have been far wiser to have occupied a rented building until the business was established. In renting, selection of location narrows down to the buildings available, and while an ideal location is rarely found, still, by balancing all factors, the one most favorable can be chosen.

Sources of Information.—Information as to various locations can be secured from a number of sources, among them Boards of Trade, Chambers of Commerce, railroad industrial agents, U. S. Census Reports, U. S. Department of Labor Reports, United States Department of Commerce, State Department reports, trade papers, trade associations, local newspapers, consulting engineers and engineering societies.

Summary.—In launching a new enterprise, the first step is to form clearly in mind just what it is you intend to accomplish. Then with this aim in view, study the problem from every conceivable angle. The analysis will take a form somewhat as follows: the product, its nature, value and volume; the plant requirements, layout, type and construction of buildings, heating, ventilating and lighting; the equipment required; the labor, supervision and management requirements, and the actual location and site of the plant. Such a study will bring out the size of the problem involved, will bring to light weaknesses, so that they may be corrected, will indicate difficulties that are bound to arise in the future, so that they can be guarded against and steps taken to avoid or minimize them, and will prevent many costly errors.

Thursday

Report Tuesday

CHAPTER IX 17

CHARTING AND RECORDING THE ORGANIZATION

Organization Charts.—After an organization has been built up, it is most difficult to visualize it as a whole to see whether the plan of organization has been logically carried out, and to discover hidden weaknesses in the structure. For this and other reasons, a chart of the organization is drawn. This chart shows graphically the relationship of functions and the flow of authority and responsibility, bringing out clearly the relations that exist between the various divisions and individuals. Organization charts can be of great assistance also in planning the set-up of new concerns and in reorganizing old ones. If those in charge of organization work analyze their problems and prepare a chart showing the organization as they think it should be, they then have a definite pattern or design to go by. Although the standard set in the chart may not be reached, it acts as a guide in the development of the organization, serving to prevent errors and tending to have the resulting organization more nearly approach the standard desired, than it would if the organization were developed with the ideas of those developing it merely carried in their minds, instead of thought out to a logical conclusion and drawn on paper.

While the advantages to be gained from the use of organization charts are more marked for the larger concerns where a great number of persons are involved, they can be of decided benefit to comparatively small concerns. There are probably few of us who cannot point to a concern the growth of which is retarded by constant irritation and dispute arising from differences of opinion that can be traced directly to overlapping of authority and responsibility. This could be overcome in a great measure by merely the use of good common sense, amicably settling the lines of authority and responsibility once and for all, and then guarding against a further occurrence of differences by charting the organization with the lines of authority definitely shown.

Drawing the Chart.—In drawing an organization chart, the inexperienced person is likely to make the mistake of trying to show too many details, thus making the chart complicated and difficult to read. Accuracy, clearness and simplicity are the essential requirements. Figure 24 shows simple forms that are easy to draw and easy to read, and so have much to recommend them over the elaborate methods sometimes employed by the novice.

Figure 24-B is a suggested form to be used when a great deal of information must be condensed to fit into a small space. Block 1 in

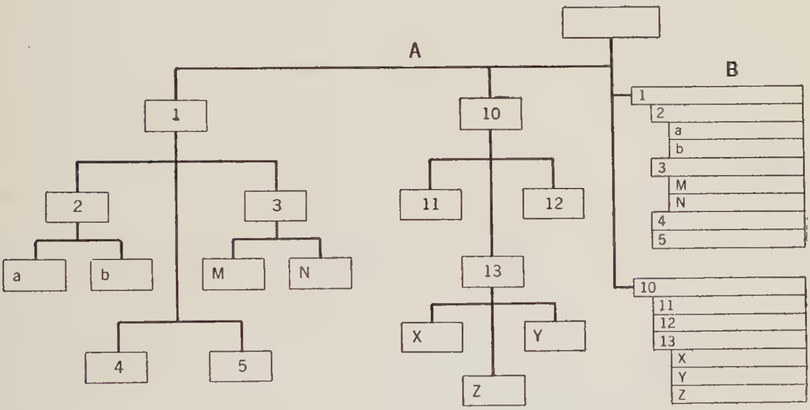


Figure 24. Illustrations of Chart Drawing

B is equivalent to block 1 in A, block 2 in B is equivalent to block 2 in A, etc. Such a form has the advantage of being compact, but it is not so easily read as the form in Figure 24-A.

Relative rank of office is indicated by the position of the boxes in the vertical scale of the drawing. Thus the office shown in box 1 of Figure 24-A would have the same rank as the office shown in box 10, but would have a higher rank than that shown in box 2. The offices shown in boxes 2, 3, 4 and 5 would have the same relative rank, boxes 4 and 5 being placed in the position they are on the chart merely to conserve space. In such instances, the nomenclature used in naming the offices which appear on the chart would make matters clear.

When it is desired to make a distinction between direct authority and advisory capacity, full lines are used to indicate direct authority

and dotted lines to show advisory capacity. Thus, the various advisory committees in an organization may be indicated by dotted lines. Any other information which it is desired to give can be shown by a distinctive line, as for example, a dot and dash line. In all such cases, the legend or key should be clearly given at the bottom of the chart.

Nomenclature.—In order to have the organization uniform, standard nomenclature should be used. Much confusion results from the indiscriminate use of the word department. It is not at all uncommon to have all the various subdivisions of a concern, both major and minor, designated as departments—on the one hand, having the sales department a major division, and on the other hand, the shipping department, the stenographic department and the mailing department minor divisions, yet all designated by the same name. The United States Government has standardized its nomenclature as follows:

Department
Bureau—a subdivision of a department
Division—a subdivision of a bureau
Section—a subdivision of a division

W. H. Leffingwell in his book on "Office Management" uses the following standardization of nomenclature:

Department
Division
Section
Sub-section

In industry the following nomenclature, if adopted as a standard, would probably prove very satisfactory and would serve to eliminate the present confusion of terms. Note that on the whole it is quite along the lines of the standards adopted by the United States Government and by W. H. Leffingwell in his work on "Office Management," the differences being those required to more fully fit the specific needs of the industrial organization.

Department (reporting direct to the general manager)
Division (reporting to their respective department heads)
Sections (reporting to their respective division heads)
Shops, Rooms, Aisles, etc.

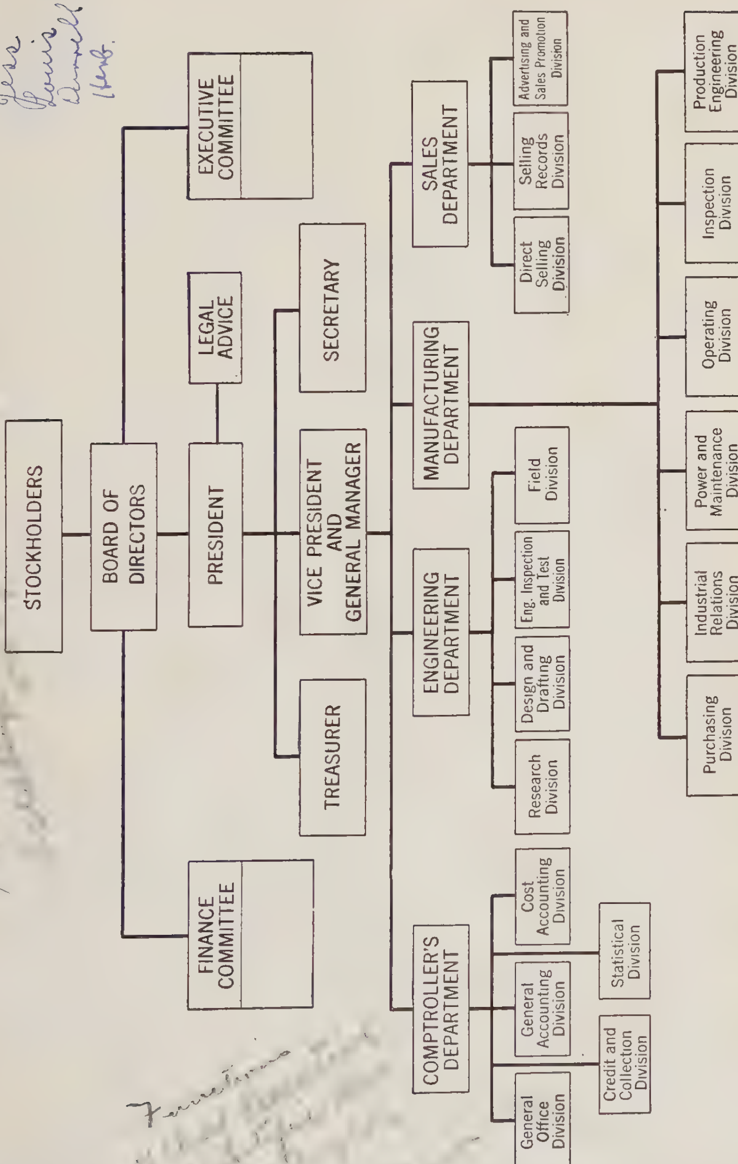


Figure 25. Typical Organization Chart of a Manufacturing Company

Charts Required.—Instead of one complicated chart, it is often better to draw a series of charts, each supplementing the other. For example, there may be a master chart showing the organization as a whole, but only carried down to the main subdivisions of departments, and then separate charts of each individual department showing the divisions and their subdivisions. In a large concern it may be necessary to go still further and have charts in detail of each of the main subdivisions.

Figure 25 shows a master chart, Figure 26 a chart of the manufacturing department, and Figure 27 a chart of the machine section of the operating division. It is at once apparent how complicated a chart would be if it showed all the information given on such a series of charts as those of which the above figures are only a very small part. In addition, the chart would have to be so large as to be awkward to handle, or, if reduced in size, the printing would hardly be legible. Costs too would be unduly high, as in many instances all the information desired would be that in regard to a single division, the remainder of the chart for the particular purpose being wasted.

Charting an Organization.—In preparing organization charts of an established concern, care should be used to see that the charts portray conditions exactly as they are, and not merely as the author thinks they should be. One of the greatest values of organization charts and write-ups is the knowledge gained through the study of conditions made necessary in compiling the data.

The thorough analysis of organization conditions, the impartial study of personnel, and the actual putting down in black and white brings out forcefully loose ends and weaknesses in the organization structure that otherwise would never be recognized and would continue an ever-fruitful source of waste and an unsuspected obstacle in the path of the growth and development of the company. Only too frequently, some, if not all, of the following conditions are found in the course of a thorough, unbiased study:

1. *Important Functions Neglected.* During a recent period of dullness in the textile industry, the president of a medium-sized mill made a thorough study of conditions and found that the dyeing of the cloth was being given very little attention, the manager being content to leave the running of the dye house to the man he had placed in charge of it, a good man for the actual work of dyeing, but one with

few thoughts beyond that. Conditions were found to be very wasteful, the cloth being put through in small batches which very materially

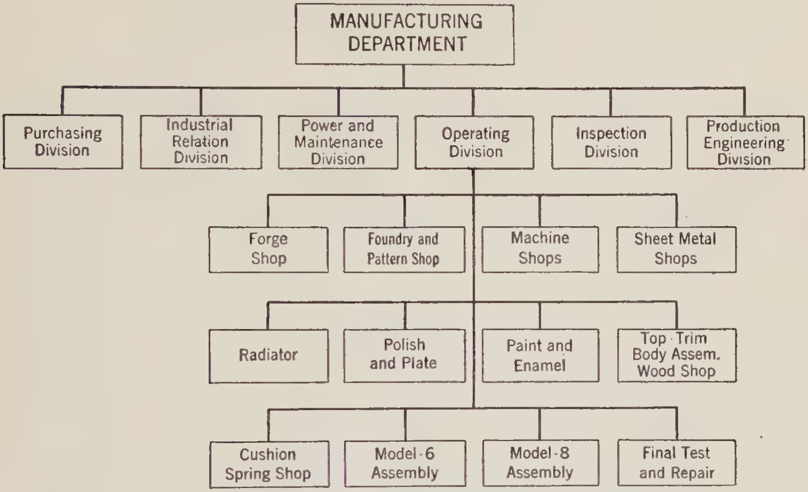


Figure 26. Organization Chart of the Manufacturing Department

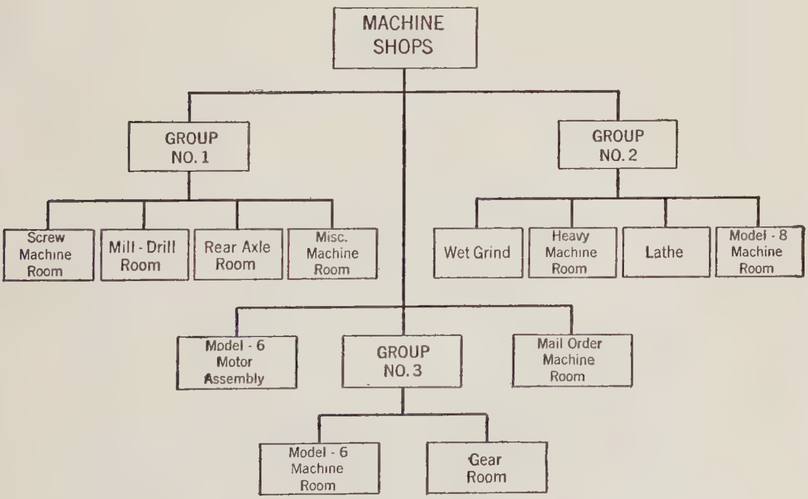


Figure 27. Organization Chart of the Machine Section

increased costs. After studying the situation and discussing trade conditions with the executives of several mills in the immediate

vicinity, the president took on a contract with the other mills to dye their cloth for them, thus allowing them to close their dye houses until business improved and permitting his dye house to send through cloth in larger batches and at a much lower cost than any one mill could possibly get by running its dye house independently.

2. *Unimportant Functions Stressed.* Practically everyone can recall a concern in which an unimportant function has become the hobby of the executive in charge and given attention to the detriment of more important functions. Plant maintenance, while an important function, can be stressed past the point of necessity and become extravagance. A so-called efficiency expert stressed the importance of cleanliness and neat appearance of the plant to the point where there was so much "redding up" that the workers half the time did not have their tools in a convenient place to work with.

3. *Duplication of Functions.* In an automobile concern it was found that in getting out certain data three different divisions were each duplicating a part of the others' work. The responsibility for getting out this particular data was centered in the proper division, with the result that the required data were gotten out equally well at a fraction of the former cost.

4. *Functions Split Among Departments.* When this occurs, they become a secondary consideration. When each department purchases its own supplies, the several department heads look upon purchasing as a decidedly secondary consideration, with the result that such purchasing is rarely efficient.

5. *Functions Not Arranged Logically.* Factory accounting being under the operating division of the manufacturing department instead of under the comptroller's department is a case in point.

6. *Executives Burdened Unnecessarily.* Many departments and divisions, irrespective of the importance of their work, may report direct to the general manager or other major executive, thus burdening executives with a mass of details, so that they are not free to devote themselves to their true functions.

7. *Men of Ability in Subordinate Positions.* The writer has in mind a man who for years held a subordinate position in a large department store. With the reorganization of another store in the immediate vicinity, he was offered a position under the new management. This position gave him an opportunity to show what he could do, with the result that his work proved so successful that another

store hearing of and observing his ability offered him a position as merchandise manager with a salary of $15,000 per year. No doubt in the first store he would have proved invaluable to the company, if he had not been kept in the subordinate position.

8. *Mediocre Ability at Important Posts.* Important positions held by men of mediocre ability or by men not fitted for the particular work is often discovered. Chance or influence frequently places a man of mediocre ability in an important position. The World War, with its unusual demands on industry together with the lack of men of executive calibre, placed many men of mediocre ability in important positions. This was by no means one of the least important causes of the need for reorganization at the close of the war.

When a position is not being filled satisfactorily, it proves frequently a detriment to both the company and the man holding the position. In many instances when such men later are placed in positions for which they are adapted, the change brings surprisingly good results.

9. *Specialists Handling Functions Out of Their Line.* A production man handling factory costs, an accounting function, is a condition found only too often in factories. The result is that true costs are not known. A production man is first and last a production man, not an accountant, nor can he be made one readily. The accountant and the production man are both specialists, and should not be expected to handle successfully work out of their line.

10. *Same Person Handling Several Unrelated Functions.* Where a man is willing and has ability, it frequently happens that he is given more and more functions to handle. When these functions are unrelated, it is invariably detrimental to the interest of the company as well as unfair to the individual.

When such conditions as above described are found to exist, the organization structure should be thoroughly analyzed so as to seek out and correct all weaknesses. A chart should then be drawn, showing each function properly taken care of, the necessary departments, divisions and subdivisions all arranged in logical order, and the functions and personnel in harmony.

Making Changes in the Organization.—In adding to the responsibilities and authority of a person, or in taking away certain of his duties, or in fact in making any changes in the personnel of the

company, all changes should be made diplomatically and with tact. "Rough-shod" tactics, while they may have their place in a few instances, are rarely conducive to that spirit of teamwork which is so essential to lasting success.

In cases where marked changes are contemplated, the distribution of organization charts should be deferred until after the changes have been made, otherwise resentment of changes and a feeling of instability may develop throughout the organization. This does not mean, however, that organization charts once issued should never be revised. Charts to be of practical value must be kept up-to-date. They must be contemporaneous pictures, not mere history.

Writing Up the Organization.—In addition to bringing out clearly the lines of authority and responsibility as given on the organization chart, to complete picturing the organization and its work it is necessary to define the general policies of the company, its rules and regulations. In addition, it is most essential that each executive, and, in fact, each individual employee should know in regard to his own department or division its scope and function, his own particular place in the department and his duties. In order that the information be available at all times, it is customary to put it in clear, concise language in the form of manuals.

Under such a method the duties of the various executives are made explicit and clear, so that there can arise no disputes over a possible overlapping of authority or responsibility. The concern which has the duties of its members specified in black and white is usually on a pretty firm foundation. The very act of specifying the duties of the various individuals that make up the organization has compelled a careful study of the plan of organization and the means of carrying out the plan as outlined. By specifying duties and assigning them to the proper person, there is a practical assurance that they will be adequately cared for, and if for any reason they are not, then responsibility for the failure is automatically fixed and cannot be sidestepped.

There are two classes of manuals:

1. The policy manual which contains general information regarding the company as a whole.

2. The department write-up which applies only to a given department and serves as the specifications for the scope of the department,

its function and duties. Such a write-up is an important factor in organization work and should be made for each department. The following gives an idea of what should be included.

1. Concise statement or description of the function and its scope.
2. Name and location of the department.
3. Title of the department head.
4. General duties of the department.
5. Specific duties of the head of the department.
6. Opportunities of service—with other departments and with the company as a whole.
7. A list of the divisions of the department.
8. For each division listed should be given name, function, titles of division head, duties of the division and specific duties of the head of the division, opportunities of service and a list of the sections in the division. When necessary, each section may be similarly treated.

Advantages of Charts and Manuals.—In addition to the many advantages gained through the careful consideration of all phases of the business made necessary in the work of charting and writing up an organization, there are other marked advantages, among them the following:

1. Definitely fixes responsibility and authority and puts it in "black and white," so that it cannot be misinterpreted.
2. Specifies the functions and duties of all departments.
3. Does away with oral instructions and its many disadvantages.
4. Does away with "snap judgment." (Changes on charts or in manuals are made only after careful consideration and authorization by the proper person.)
5. Gives every employee a conception of the company as a whole, his place in the organization and the probable line of promotion open to him.
6. Assigning of titles is made easy. (There is a clear relationship between titles and incentive.)
7. Used in grading and classification of work or tasks, which in turn determines the fixed salaries and wages.
8. Aids in determining the budget program.
9. Aids in cost analysis.

Standard Practice Instructions.—When a concern has adopted organization charts and organization manuals, it has developed to the degree where it has, as Dexter S. Kimball [1] aptly put it, "potential power only; it is static so to speak. It is comparable to a well-drilled and well-officered regiment, where each man fully understands his functions but, lacking marching orders, has no idea where to proceed or where to start." The next step for such a concern to take is to think out clearly its methods of procedure, perfect and standardize them, and put them in writing in the form of standard practice instructions, sometimes spoken of as standard procedure instructions, standard orders, or general orders.

In the average case, there are several ways by which a given result can be obtained, but almost invariably there is one best way. This thought holds true whether the problem be of sales, engineering, accounting, production, or what-not. To determine the best procedure is often a complex and difficult problem requiring great care and thought, but once the method has been developed and adopted as a standard, the matter becomes one of routine, the daily decision as to method has been done away with, and the chances of retrogression are minimized. In those concerns still under rule-of-thumb management, each individual in the organization thinks out his problems separately, with the consequence that there is a great body of common practice largely unrelated. As there are no standard methods there can be no standard results. The product varies with the methods of the workers producing it. Accurate cost figures cannot be determined, as costs vary with methods used. The atmosphere of the plant is very likely to be one of constant irritation. The executives are invariably high-strung, overworked individuals, making countless decisions from day to day as the occasion arises. Their decisions as to the same question frequently vary, being largely influenced by the circumstances under which they are working when the question is put to them.

Due to absence of records of methods used, knowledge of advances in methods are often lost, just as many of the arts of ancient times were lost to the world due to the lack of means of recording them. Likewise, instructions being given by word of mouth, they are variously understood and interpreted by those receiving them. In-

[1] Dexter S. Kimball, Principles of Industrial Organization, page 105. McGraw-Hill Book Co., 1925.

structions written in clear, concise language permit of ready understanding and of but one interpretation. There is, therefore, no reasonable excuse for error.

Standard Practice Instructions—Their Use and Improvement.—A standard practice may be defined as the method or means of accomplishing a task adopted as the model or standard to which all

THE —— COMPANY

GENERAL ORDER NO. 42 DATE—Jan. 31, 1928

SUPERSEDING PARAGRAPHS 8, 9, 10, 11 AND 12 ON PAGE TWO OF GENERAL ORDER NUMBER 37

Inquiries for quotations for outside work will be sent to the Vice-President in Charge of Production. They will then be sent to the factory for estimate. The factory will estimate by using the talent in the department where the piece is to be manufactured, who will check it through the Production Engineering with the Production Manager and it will be signed by the Works Manager.

The estimate will then be sent to the Cost Department, and they will check this estimate with any known manufactured piece of similar size, shape or characteristics. These estimates, after being so checked, will be returned to the Vice-President in Charge of Production, and he will then send out his quotation, a copy of the quotation together with the original estimate going to the Cost Department to be filed. On the quotation there will be a note advising the prospective customer to send the purchase order, if any, to the Cost Department, attention of Mr. ——. The purchase order will be checked against the quotation and then sent to the Production Department, which will issue the proper order for performing this work. This department will then insert on purchase order the job order number under which the work is to be performed, and forward the purchase order to the Parts Department, which will issue the necessary blanket mail order for shipping.

This function will be the same as is now in operation for the handling of material for the subsidiary plants, and this same procedure will be followed for all outside business.

....
Comptroller

APPROVED:

....
Vice-President

Copy 12.8.27 JCS

Figure 28. Standard Practice Instructions

subsequent performance of that task must conform. A standard is not an ideal, but is that which is considered the best that can be devised under existing conditions. Figure 28 gives the method of

procedure to be followed in handling an inquiry for quotations for outside work, as used by a well-known manufacturing concern.

Note that in Figure 28 the standard practice instructions are signed by both the comptroller and the vice-president. This serves as a check upon unnecessary or hasty, unthought-out changes in the methods already in use. All standard practice instructions are issued through regular organization channels to all those affected by the order. An illustration of another type of standard practice instructions is the "Production Booth Instructions" in Chapter XXVIII.

Advantages of Standard Practice Instructions.—Standard practice instructions are of great value to both the management and the workers. To the worker, the detailed directions serve to minimize the chance of error, to relieve him of the task of planning his method of work (a task for which he is rarely well-fitted), and to save him from much unnecessary effort through eliminating wasted motion.

For the management, the very act of devising standard instructions serves to clarify the ideas of those responsible for the establishment of the instructions. The careful thought needed in devising the best method of procedure and in making it so clear that the average operator can readily understand it, serves to bring out for correction any weak points. The resultant improvement in method of doing work frequently brings with it a materially increased productivity of labor and a reduction in operating costs. The standards once established, executives are relieved of further deciding questions in regard to the particular tasks covered by the instructions. Such work becomes a matter of routine that can be safely left to subordinates. The executives thus relieved have time to perform their true function, that of supervision, control and further planning. Supervision is made more simple, as the standard practice instructions supply a definite means of checking performance. Control is simplified; as all who perform a given task have the same standard to follow, errors are readily detected and responsibility is automatically fixed. With executives freed from routine and with time to plan future work, the company secures full benefit of the brains of the organization. There are many who can follow instructions; there are few who have the knowledge and ability to plan in advance the details of methods of work. The keynote of modern management is the full utilization of the brains of industry.

CHAPTER X

IRREDUCIBLE MINIMUM OF ORGANIZATION FUNCTIONS

Organization Functions.—There are certain functions which are common to all manufacturing businesses, no matter what the size or class. The performance of more than one of these functions may be centered in the same person; nevertheless, each exists as a

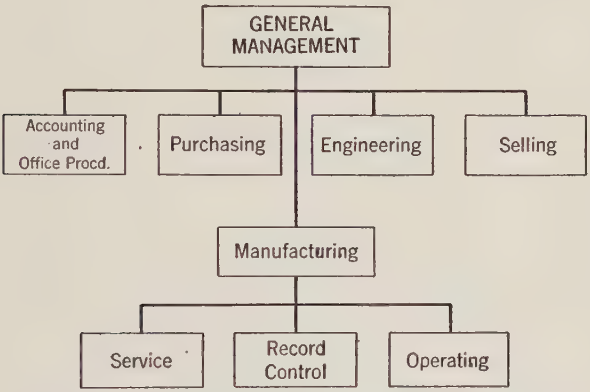


Figure 29. An Irreducible Minimum of Organization Functions

distinct function. Figure 29 shows the minimum functions which must be performed. The following briefly describes each function. A more thorough discussion will be given in subsequent chapters, a chapter being devoted to each function, with the exception of the function of general management which will be considered here.

1. **General Management.**—Under the general management function is included the formation of the basic policies and the direction, coordination and control required to see that these policies are accordingly put into effect and carried out. The formulation of sound policies requires business judgment based upon knowledge of past

attainment in that field of business activity. It involves knowledge of what has been done, what is being done and how it is being done. In the light of this knowledge and a comparison with what is to be attempted, it can then rather definitely be determined whether the policy being formed is sound and workable. If existing standards of performance do not even approach the standard being set for attainment, and it is found that these existing standards are based upon the most advanced methods and practice, then the policy that requires such an abnormally high standard is not practicable. Policy formulation presupposes experience and judgment on the part of those forming them. The policy-forming group in the organization, therefore, must be most carefully selected, as their work lays the foundation for the success or failure of the enterprise.

Equal in importance is the part of the directing, controlling and coordinating element in management. The larger the concern and the greater the division of effort, the greater is the problem of control and coordination. Coordination of administrative effort is the most difficult problem in management. It is one thing to design a factory building, to gather the brick, stone, steel, mortar and other materials, to fit the parts together to form the whole. It is quite a different and far more difficult matter to coordinate effort, to bring together the minds and personalities of men in different channels of work, so as to produce in a given time a given result.

The caring for these two vital functions, policy formation and direction, control and coordination, is the work of the general management. The official titles included under the heading of general management vary in practice. In some concerns there are a president and one or perhaps several vice-presidents. For example, there may be an executive vice-president, who performs the functions of general manager, a vice-president in charge of sales, a vice-president in charge of production, another in charge of finance, perhaps another in charge of personnel work. Another concern, according to its needs, may have merely one person who acts as president and general manager, dispensing with vice-presidents. In all cases, however, the same functions exist, and they must be provided for. In the following discussion the intention is to describe the functions common to all manufacturing businesses, and the qualifications necessary to perform these functions, rather than the functions allotted to and the powers vested in any one prescribed set of officers.

Board of Directors.—In a corporation, the board of directors is elected by the stockholders and is responsible to the stockholders for the administration of the business. The number of directors varies according to circumstances; there may be three or there may be twenty, as required in the particular concern and so set forth in the by-laws. The members of the board are elected due to a variety of reasons, principally the influence of their name, the amount of their investment, their special interest in the concern or their particular knowledge, or the office or position they hold. In each instance, election depends upon the service that has been rendered to the company or that is expected to be rendered in the future. This service may take the form of financial interest, expert advice, or influence in the matter of securing valuable contracts. Ordinarily, it is not advisable to limit membership on the board of directors to officers and executives of the company, as this tends to narrow the viewpoint of the board and does not provide that highly desirable check upon the active management of the company's affairs.

The board of directors formulate the broad, general policies and select those who are to actively control the business and who, in turn, are directly responsible for their actions to the board. Due to the power vested in the board of directors, frequently a group of stockholders will put forth strenuous efforts to secure sufficient voting power through ownership of stock or influence over other stockholders, to secure control of the board, and so influence the selection of officers and the administration of the business to their own best interests.

The board of directors frequently selects from among its members a small group to form an executive committee which is authorized to act for the board in the intervals between board meetings. While very important matters are ordinarily deferred for action until a meeting of the full board, the executive committee has broad discretionary powers and in a few instances may even possess and exercise all of the powers of the board in the management of the affairs of the company. The advantages that may be derived from having such an executive committee are at once apparent. Ordinarily, the members chosen are those whose experience best fits them for taking an active part in company affairs. Due to their close contact with one another and with the officers and other high executives of the company, they develop a greater interest in and deeper insight

into company matters and needs. This, coupled with their experience, makes their work of invaluable benefit to the company. Likewise, as choice of members is centered in those who can be quickly and conveniently called together, frequent consultation is possible with the officers and high executives, and there is therefore a closer coordination of administrative effort with that of active management, direction and control.

President.—The president is the chief administrative officer in a company. His function is to represent the board of directors and to see that their wishes are carried out. To fill his position adequately, the president must maintain at all times a broad perspective. He must keep himself thoroughly familiar with general business and trade conditions, so as to be able to recognize immediately any changes in those external factors which have a bearing upon the conduct of his company. With this knowledge, he is then in a position to advise the board of directors intelligently, and with his associate officers, the general manager and major executives, to plan to offset any detrimental influences or to take the fullest advantage of any beneficial influences. In this way he acts as a balance-wheel, keeping his company in harmony with outside business conditions. In those concerns where one man performs both the function of president and that of general manager, the task of the president in regard to external relationships is largely taken over by the chairman of the board of directors.

Treasurer.—In practice there is no one plan used in caring for the financial function. The method of organization here discussed provides for a treasurer and a comptroller. The treasurer is the officer in charge of the funds and securities of the company. In conjunction with the president, he formulates the financial policies of the company subject to the approval of the board of directors. His work is purely of a managerial nature in respect to financing, the detail work in connection with financial accounting being under the accounting function. In other words, the treasurer is the officer of the company chiefly concerned with the big financial problems. He has control of investments, the purchase and sale of property, the investment of excess funds.[1] It is his responsibility to see that all

[1] In those concerns where the board of directors elect a finance committee to have control of the financial affairs of the company, the control of investments is under their jurisdiction.

taxes are promptly paid and that the assets of the company are adequately covered by insurance. Likewise, he has charge of credits and collections, although in some instances this may be cared for under the comptroller's department. The treasurer superintends the payments and receipts, and sees that all funds are deposited to the credit of the company in such bank or banks as the board of directors shall designate. He is concerned with the relationship between the company and the bank, arranging for short-term loans when necessary, and making provisions for their payment when due. He must be prepared at all reasonable times to exhibit his books and accounts to any director of the company upon application at the office of the company during business hours, and he must perform any other duties incident to the position of treasurer, as set forth in the by-laws of the company or assigned to him by the board of directors.

General Manager.—The function of the general manager is so to coordinate, direct and control the organization that the various departments work together as a unit. To this end, he determines the type of organization, selects the men to be in charge of the various major functions, and in conjunction with them determines for their departments the major policies and, broadly, the methods to be used in carrying out these policies, leaving the technical direction and details to the department heads. These major policies must in all instances tie in with and conform to the general policies laid down by the board of directors.

Where the function of the general manager is not adequately taken care of, the organization is likely to become merely an aggregate of units working irrespective of one another, and even in some cases at cross-purposes. The head of the manufacturing department devotes his entire time and energy to the problems of production and feels it is up to the sales department to sell what his department produces. He has no close contact with the sales department, so does not appreciate their problems or the need of coordination of his production program with sales plans and expectancies. Likewise, the sales manager is so engrossed with his sales campaigns and the administrative problems of his department that he gives little thought to the needs of the production department. To him the function of the production department is to produce the goods the sales department sells in the quantity and at the time needed. He little

appreciates the effect upon labor and plant operation if production must fluctuate in accordance with the fluctuation in sales from period to period. Irritations arise, due to lack of appreciation of one another's problems and of an adequate provision for coordination of activities. Similar conditions arise in the relationship of the purchasing and manufacturing departments, of sales and accounting, and so forth.

It is the function of the general manager to iron out differences between departments, to do away with departmental jealousies, to see that no one department develops unduly at the expense of other departments, but that each bears the proper relationship to the other and to the whole. In other words, it is his function to bring about unity of purpose and action. This does not mean that pride of company should completely eliminate all pride of department. A friendly rivalry between departments gives a zest and interest to everyday work and should be encouraged. It is the duty of the general manager to see that this wholesome rivalry remains a constructive force and does not get beyond bounds.

A point that can hardly be overemphasized in considering the function of the general manager is that the successful general manager is not the manager who carries alone the entire responsibility for the operation of the organization and who feels that he alone must settle all questions of weight. It is not the place of the general manager to do all the work himself. He is responsible for efficiency and unity of action, and to this end he should so select and guide those under him that he can trust the responsibility for the work assigned to them directly to them. If a perceptible weakness should develop in a department or if a department is expanding more or less rapidly, the general manager, for the time being, may have to devote considerable attention to the needs of that department, but at no time should he aid the department head to the point that the latter becomes dependent upon him or forgets the fact that, after all, the responsibility for the conduct of a department rests with the department head himself.

The general manager is always the coordinating center of all managerial activities of the business, the balance-wheel which keeps the departments in harmony. He is the leader of his organization, the one who creates the teamwork necessary to reach the goal set.

This essential teamwork, this wholehearted, intelligent cooperation cannot be demanded—it must be won. This is the work of the general manager.

2. Accounting and Office Procedure.—The accounting function includes the devising of proper methods and systems of record control, the compiling of the necessary data for these records and the getting out of the required reports and statements in the form and at the time needed. The performance of this function is the responsibility of the comptroller who has charge of all detail work in connection with financial accounting as well as the provision for office procedure.

3. Engineering.—The engineering function includes the design of the product and the tools with which it is to be made, the preparation of drawings and specifications of what to manufacture, and the necessary data for planning production. In carrying out its function, the engineering department must study the product from three distinct standpoints: first, good engineering practice; second, the ease and economy of manufacture; and third, the salability. The function of the department further includes research work for the improvement and standardization of the design and the development of new products.

4. Purchasing.—The purchasing function covers the procurement of all raw, semi-finished and finished materials and parts, equipment and supplies necessary for the efficient conduct of the business. Effective purchasing involves the factors quality, quantity, time and cost, that is, the procurement of goods of a quality best adapted to the use to which they will be put, in the quantity desired, at the time they are required, and at a minimum of cost.

5. Manufacturing.—The manufacturing function involves taking the purchased materials and by the proper use of labor, machinery and equipment transform the materials into a finished product as per the drawings and specifications issued by the engineering department. The manufacturing function includes three distinct sub-functions, namely, service, record control and operation.

Service. The service function covers power, repair and maintenance, safety, plant transportation, inspection, labor employment,

etc., anything which facilitates operation, and leaves the operating division free to devote its entire time to actual production.

Operating. The operating function covers the actual making or fabrication of the product.

Record Control. The function of record control is separate from both service and operating, but serves to "tie in" the both together.

6. Selling.—The selling function covers the distribution of the product. This includes not only the actual making of sales, but the development of the market through the selection of the channels of distribution, sales promotion work and advertising.

Summary.—The organization of the modern industrial enterprise does not rigidly follow any one particular pattern, but all are moulded about certain fundamentals. The organization is built around functions. The above functions common to all businesses must be taken care of in every industrial enterprise, although the form which the individual functions take may vary with the particular concern. The importance of each of the functions and their indispensability to all industrial enterprises will be more fully appreciated when the functions are taken up in detail in subsequent chapters.

CHAPTER XI

COMPTROLLER'S DEPARTMENT

Standards and Records.—In order to eliminate guesswork in management, provision must be made for supplying to the general manager and other executives accurate and comprehensive information upon which they can base their decisions and formulate their plans of action. In small concerns much of this necessary information comes first hand to the executive, or is passed along verbally in the direct contact of executive and worker. As the size of the concern increases, more and more reliance must be placed upon written reports. The reports of themselves do not give the desired information for correct planning. It is necessary to have established, in addition, a standard [1] for comparison, so as to know whether or not the work or conditions portrayed is satisfactory. With standards decided upon in advance and with reports at regular intervals, the executive then has all the information needed, and by applying his judgment and experience he can intelligently plan and control.

Standards.—A standard is a measure set to gage efficiency. Without such standards or measuring rods, the executive is only working in the dark. His decisions at best are only guesswork. He has no definite basis for comparison, no way of knowing whether his organization is working at its full productive capacity or how far it falls below the level it is capable of reaching. In order to adequately control an organization and to have it maintain the highest possible degree of efficiency, there must be established standards for every phase of the work—financial standards, standards of performance, of methods, of materials, and so forth. In other words, there must be established all the various standards necessary, by which to evaluate current performance and estimate and plan for future performance. The following illustrations may give a conception of the

[1] For the purpose of this discussion the term standard is understood to refer to administrative standards, rather than to technical standards of operation.

variety of standards involved in the operation of an industrial enterprise.

Standards of Procedure.—In the performance of an activity in which two or more departments are involved, each department must know definitely what it is to do, how it is to do it, and when it is to do it. A standard of procedure for such an activity would give this necessary information, thus not only reducing the chance of error and facilitating the work of the individual departments, but tending to prevent conflict between them and coordinating the activities of all. In a material control system, for example, a standard of procedure would outline the operations to be performed by each department involved, and the sequence of operations covering each successive step from the purchase requisition to the actual issue of materials by the stores division, and the allocation of costs by the cost division. Likewise, in the handling of an order and in all those other activities which require the cooperation of two or more departments in their performance, for effective control, standards of performance must be established. In a similar manner, standards of performance must be established for those activities which are strictly departmental in scope. In this way, the management has definite standards by which to evaluate the performance of each department, each division within each department, and so on down to each machine and each worker. By knowing how much should be done, when it should be done, and the quality required in the finished work, and comparing actual performance with this standard, it is possible to detect deviations at once and so determine just where lie inefficiencies and at what point there is a slowing up of operation. In this way, responsibility can be immediately and firmly placed and necessary changes and improvements made.

Financial Standards.—Again the standard may be a financial standard, as for example, the ratio that should exist between current assets to current liabilities, the ratio of sales to inventories, and so forth. Financial standards are given in the form of ratios, as they represent relationships between the various parts of the financial structure and relationships are best expressed by means of ratios. The amount of current assets is an important item on a financial statement, but of even greater importance is the relationship of the current assets to the current liabilities, as the latter indicates to the

executive the ability of the company to pay its current debts. Likewise, the value and volume of sales is another important item, but it does not begin to hold the significance of the relationship of sales to inventories, as the latter indicates the rate of stock turnover, a most vital factor in industrial operation, as the more rapid the rate of stock turnover the smaller the amount of capital required to handle a given volume of business.

Operating Standards.—Financial standards cover a group total, as for example, sales or assets. They are based upon the balance sheet and profit and loss statement, and can only be checked against actual performance when these statements are gotten out. As the period between the financial statements is frequently as long as six months or a year, another type of standard is employed to permit of more frequent comparison of standard and actual performance. This standard is spoken of as an operating standard, as it covers a single operation or condition, as for instance, the ratio of selling expense to sales for the individual salesman. This standard is based on the daily or weekly reports of the salesmen and permits of current check. In establishing such a standard for one concern, it was revealed that there was a variation of 100% between the ratio of expense to sales for two of their salesmen. After a thorough investigation, a standard was set of approximately the same ratio as that of the salesman whose expenses were so markedly lower than that of his fellow salesman. The salesmen were informed of the standard set and of the check being kept, with the result that the next financial statement issued showed a very marked decrease of selling expense, even in the face of increased sales.

Standards are set only after most careful consideration of all influencing factors. The standards established are not necessarily the highest possible attainment. That in many cases would not be practicable nor fair to those whose work is to be judged. Standards to use as guides in measuring results must be those which are within reach under the present working conditions. If later improvements are made the standards should be raised accordingly.

Records.—Records give in written form a statement of operating conditions or the results of operations, and permit of ready comparison of actual performance with the standards set.

Standards and records are as inseparable ideas as latitude and longitude, debit and credit, east and west. Standards without records are as ineffective as firing at a target would be if the marksman had no means of determining whether he was making hits or not, and vice versa, records without standards would be equivalent to carefully recording the results of every shot but giving the marksman no definite target at which to aim. A very common illustration of standards without records is presented by the concerns who issue many rules and instructions but provide no systematic method of ascertaining whether such instructions are followed, with the inevitable result that they are "more honored in the breach than in the observance," and in the innumerable systems which are operated in a way far different from that originally intended." [2]

If records are to be effective tools and bring to management the information necessary to aid in control, they must be adequate to fit all needs and yet must not be in such numbers and detail as to develop "red tape." The number of records necessary, their form and nature, can only be determined after a careful study of the needs of the particular business in question. The following are suggestive of points to be considered:

1. *Significance.* Records should cover information that is essential to control. Unless a record serves a useful purpose and the benefit to be derived from its use is greater than the cost involved in getting out the record, it should be discontinued, as it is merely a source of waste.

2. *Time at Which Available.* Records to be of maximum use must make facts currently available. Records gotten out shortly after the close of a period showing just where the concern has fallen down or has made good during that period are of decided value in planning for and controlling the work of the next period. If, however, the records are not available until that period is well under way, they are of little value except as history. Records currently available acquaint the executive with true present conditions, indicate to him the trend and permit him to make necessary changes, to take full advantage of beneficial trends or to check, offset or correct harmful conditions before damage has been done.

3. *Simplicity and Ease of Operation.* It is unfortunate that to many business men a complex, elaborate record is looked upon as an achievement. In reality, its complexity detracts greatly from its use-

[2] G. Charter Harrison, Cost Accounting to Aid Production. The Engineering Magazine Co.

fulness, as it requires one skilled in record-making to understand it. The more simple and concise the record can be made and yet supply the necessary data, the greater the use that can be made of that record.

4. *Accuracy and Completeness.* Information, to serve as a basis for control, must be accurate or it is worse than useless. Likewise, it should be complete, as incomplete data are misleading.

5. *Logical Arrangement.* Facts should be well organized so that they follow the trend of mind of the reader. Relationships between important points in control should be so placed that anything unusual will readily catch the eye.

6. *Flexibility.* Provision should be made for the addition of details to explain where necessary the bald statement of fact; likewise for any additions or expansions that might be warranted in the near future by increased business.

7. *Correlation of Records.* Records should be designed not only from the point of view of the needs of the department, division or section using the record, but from the point of view of the needs of related departments and divisions, in regard to the information covered by the record in question. A stock requisition, for example, should be so designed that a copy of it serves the division making the requisition as its record of what materials or supplies have been asked for, and for what purpose they were used; another copy retained by the storeskeeping division shows, when receipted, what articles have been given out and to whom, and another copy sent to the accounting division gives them the information they need in accounting for stores used. This correlation of records of departments and divisions associated in the performance of an activity serves to eliminate duplication of effort and to facilitate performance.

8. *Character of Data Covered.* The character of the data to be included in the record varies with the use to which the information is to be put. If a record of the operation of a machine shop is to be used by the foreman of that shop it must, of necessity, be in considerable detail; a record covering the operation of the same shop if going to the general manager would not be in such detail, but would bring out the more significant facts in a clear cut and concise form. The foreman, being in direct charge of the workers, is interested in the details of operation of his shop. The general manager, on the other hand, having control of the entire concern, would find it physically impossible to go through the details of opera-

tion of departments. He is chiefly interested in that information which has a bearing upon the work of the plant as a whole. He wants the essential facts in a clear, concise form. When conditions indicate the necessity, he can look into the details of specific departments involved.

9. *Forms Used.* The forms used in record-keeping should, for convenience, be of standard size wherever practicable. As few different forms should be used as will adequately serve the needs, since multiplicity of forms causes confusion and waste and frequently retards business procedure. In designing a form, special attention should be paid to headings and their placement, the space necessary for proper entry of information, the clearness of type, the general appearance of the completed form and the grade of paper used. A sufficiently high grade of paper should be used to insure permanency of the record, clear impressions and good appearance. The severity of usage will also be a deciding factor in determining the grade to use, records for temporary use not requiring as expensive a paper as those for permanent use. In designing forms it is well to inquire first as to the standard forms procurable, at any well-stocked stationery store. Manufacturers of office equipment after study of the individual needs of many industries have designed standard forms to meet various requirements. Frequently, by placing the matter before the salesman of such a concern, he can suggest standard forms that will serve the same purpose equally as well as a specially designed form and at a much lower cost.

10. *Record Filing.* It is just as important that records be kept where they can be found when wanted, and where they are carefully protected as it is that they be properly compiled.

Centralization of the Standards and Records Function.—In practice there is no one plan whereby the function of standards and records is taken care of. Figure 30 shows a suggested plan of organization which could be adapted to suit particular needs and conditions. Centralization of the function is recommended, for if every department develops its own standards and system of records it invariably results in lack of coordination and a duplication of effort. In addition, centralization brings with it the added advantages gained through specialization and an impartial attitude. In other words, with the function centralized, all standards and record forms

are developed and established impartially with a view to the needs not only of the individual department, but to the needs of all other departments as well, and to the necessity for the records of one department to fit in or "tie in" with and check those of another department.

This does not mean that under the centralized form the standards are developed and put into use irrespective of the wishes of the head of the departments which cover the activities for which the standards are set. The comptroller's department sets the standards and devises the necessary record forms and methods of keeping them in joint cooperation with the head of the department or departments affected.

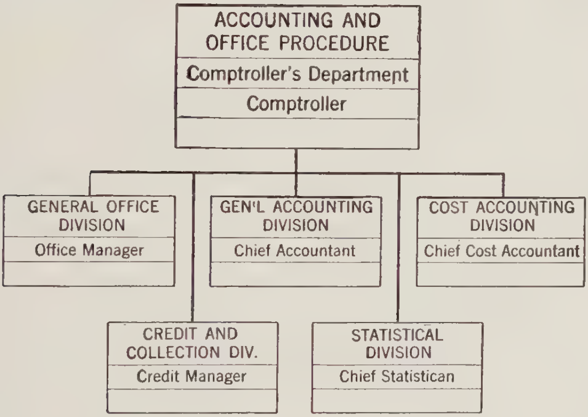


Figure 30. Organization of Comptroller's Department

Function and Duties of the Comptroller.—The comptroller is in a strategic position in the organization as his work brings him in close contact with every department of the business. His department clears every record of importance, compiles the necessary data and gets out the reports which show to the management the true status of operations, and act as a foundation upon which the management can base its plan of action. The comptroller is directly responsible for the accuracy and scope of the information covered. He must see, therefore, that proper standards are developed and established and records kept, so as to supply the information needed in compiling the required reports.

To enable him to carry out his function the comptroller is given

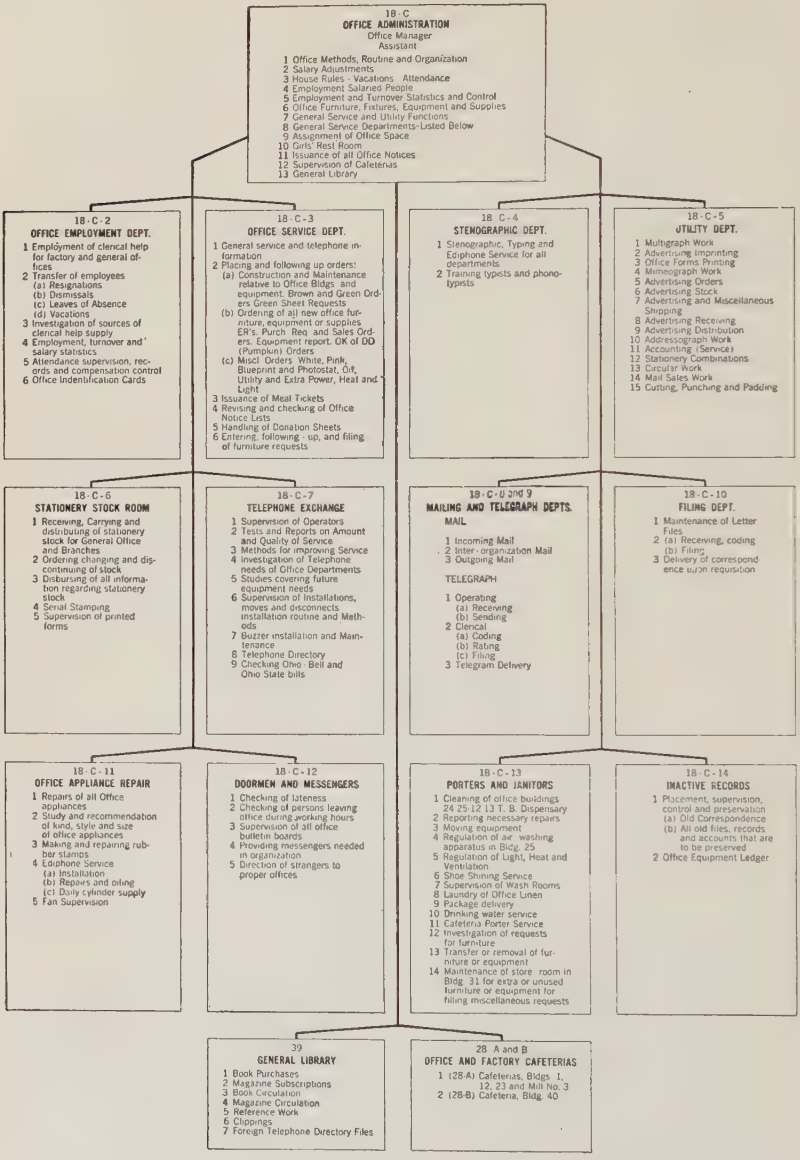


Figure 31. Organization of the General Office Division

line control over the divisions of his department, as shown on the chart in Figure 30, and functional control over standards and records in all other departments.

The General Office Division.—Receiving, sorting and delivering incoming mail, collecting, stamping and mailing outgoing mail, receiving telephone messages, telegrams, cables, etc., typing and filing of letters, messenger service between departments—all come under the many duties of the office division. The office division is the true service division for the entire concern, relieving the other departments from much routine work.

Improvements in office procedure and methods, brought about through careful planning or by the installation of mechanical devices, reflect themselves in improved service and in the cost, quantity and quality of the office work turned out.

The scope of this book does not permit of a thorough discussion of the work of the office division. The chart shown in Figure 31 and a discussion of the duties of the office manager, however, will make the work clear, as the items on the chart are largely self-explanatory.

The Office Manager, His Qualifications and Duties.—As head of the office division, it is the duty of the office manager to facilitate the transaction of business, to see that the general routine work runs smoothly and to relieve other departments in every possible way. If the office is to be a service division, then the office manager must make efficient service his aim. As Wallace Clark aptly puts it,[3] "the chief qualification that fits a man for the job of office manager is the ability to get work done." There may be men and women under him who have greater technical knowledge of the work, but he holds his position because of his greater ability to overcome difficulties and get things done.

The United States Department of Labor in its bulletin covering definitions of various office occupations gives the following definition, which states briefly and clearly what is required in the way of performance and qualification to fill the average position of office manager.

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[3] Wallace Clark, "Getting the Office Work Done," *Industrial Management*, October, 1920.

Office Manager

Description. The office manager has charge of the office and must see that each department has the proper number of employees, that the work is satisfactory, that the methods of the office are efficient, that the work is properly and promptly dispatched, and that the workers are efficiently placed. He is responsible for regular and punctual attendance, and looks after the employment, transfer, and discharge of office help.

Qualifications. He must be progressive and have a broad point of view, the power to direct others, and the ability to delegate work that can be done by subordinates. He must understand thoroughly the work of every department and its interrelations. He should be enthusiastic, alert, tolerant, firm, tactful and resourceful.

Schooling. High school higher education desirable; accountancy and business courses desirable.

Office Layout.—Intelligent office layout plays an important part in the effective and economical handling of office work. The ease with which work may be accomplished from a mechanical standpoint, the extent of cooperation secured between the various individuals and divisions of the office, and the atmosphere in general, all depend to a marked degree upon the efficiency of the layout. Whenever possible, the planning of the office layout should be done before the plans of the architect are drawn, or if rented quarters are used before the lease is signed, for of several locations to choose from, the adaptability of the available space to the proposed layout will in many cases be a deciding factor. When existing quarters must be used, frequently comparatively simple alterations made before the office moves in will pay for themselves many times over in the improved quality and lowered cost of the work turned out. In planning a layout it is advisable to provide the following simple materials to use in planning:

1. A piece of cork bulletin board for mounting.
2. Small pieces of cardboard cut to scale to show the desks and other articles of furniture and equipment. The scale should be the same as that used in drawing the floor plan. A practical scale is $\frac{1}{4}'' = 1'$. Different colors for different articles facilitate planning.
3. Strips of cardboard and pieces of cardboard cut to scale to

indicate walls and other structural features, wash basins and other facilities.

4. Thumb tacks to fasten the templates to the board. The templates can be arranged on the board and changes readily made until the most desirable layout is obtained.

In planning the layout it is always advisable to secure the ideas of the various department and division heads affected, as to their immediate and ultimate requirements in regard to number of employees, furniture and equipment, working space, and any requirements peculiar to their particular work. The Art Metal Construction Company compiled from the practices of a large number of business concerns the following figures and statements as standards by which to judge the efficiency of office layout and flow of work.

Office Layout and Flow of Work

1. In laying out the departments, sections, working units, etc., remember the old adage that a straight line is the shortest distance between two points and then, as nearly as is practical, have the flow of work conform to this principle.

2. In planning the general layout, consider any electrical or structural needs which must be conformed with in connection with mechanical equipment which is to be used.

3. Remember that office space is rented by the square foot at prices ranging from 50 cents to $3.00 per square foot per year. It is, therefore, of paramount importance that floor space be conserved, not, of course, at the expense of appearance, production or comfort, but for the purpose of eliminating uncalled for extravagance in this direction.

4. Place related departments near each other.

5. Aisles should be at least 3 feet wide.

6. Do not use the accomplishments of the fastest worker as a standard by which to judge others.

7. In assigning working space, provide for the peak load rather than for bare minimum requirements.

8. Use the past annual increase in the volume of work handled as a basis for planning space requirements for future expansion.

9. Group minor activities around major ones, so that when more space is needed the major functions will be taken care of first.

10. The type of work to be done is the basis for departmentalizing the office work.

11. Do not make a change in present working arrangements unless

it can be definitely shown to be a distinct advantage, *but conversely,* do not perpetuate existing layout if a thorough and impartial study shows that a change would make for more efficient work.

12. Each employee, including his desk, chair space and his share of the aisle requires 50-75 square feet of working space.

13. Plan to have the work flow through the office smoothly and evenly. Work that is pulled through by main force usually shows signs of wear and tear upon completion.

14. Work should come to employees rather than they go for it.

15. In any given department, all employees should face in one direction with the natural light coming over the left shoulder or from the back. Where employees must be placed back to back, it is well to leave at least 4 feet between chairs.

16. Place offices of executives largely concerned with administrative control and operation where they may be able to maintain close supervision over their departments.

17. An orderly and attractive appearing office induces respect of visitors and efficiency on the part of employees.

Centralization of Office Work.—In so far as is practical office work should be centralized. For example, all stenographic work should be done by a central stenographic department under a head stenographer. When each of the various departments maintains its own stenographic force large enough to meet the "peak load" of its busy periods, there are a number of stenographers only partly busy a considerable part of the day, or if their time is fully employed they are engaged in doing clerical work which could be done equally well or better by a clerk at a lower rate of pay. When stenographic work is centralized there are fewer stenographers needed as their full time is devoted to stenographic work and they can be used in whatever department needs them at the particular time. In addition, the work turned out is of standard quality as all stenographers are under the same supervision, receive the same training and must meet the same requirements. Likewise, all are paid on the same wage basis and work under the same general working conditions.

Centralized Filing.—Filing is too important a part of office work to be entrusted to persons inexperienced in filing, and yet that is what ordinarily occurs when each department maintains its own files. Centralization of files brings with it many advantages in addition to the very evident ones of better filing service, due to the work

being done by trained file clerks and of lowered costs, due to saving duplication of equipment and labor. Centralization of files fixes responsibility, as the head file clerk is responsible for all material filed. This is a most important factor owing to the value of data and the cost and inconvenience that can result from even a single lost or misfiled paper. In addition, information is available to all, whereas when each department maintains its own files each is likely to look upon its correspondence and reports and other data as belonging to that particular department, when in reality they belong to the company and the information should be readily available to all who need it in their work. Thus centralization lessens the possibility of duplication of the work of collecting information at much labor and expense and relieves the possibility of friction arising between departments from a lack of cooperation in supplying each other with necessary information.

Similar advantages are derived from centralization of messenger service, of mailing service, and the various other services which comprise office work. Frequently, centralization warrants the installation of labor-saving devices which could not be used were the work decentralized. The resulting saving in cost of work turned out and of facilitation of business procedure is another advantage of centralization. A point which may appear trivial and yet which will be at once appreciated after a moment's thought is the advantages to be derived from segregating, in so far as is practicable, all equipment and appliances such as typewriters, adding machines, multigraph machines, etc., the operation of which is accompanied by noise. Anything which tends to the elimination of unnecessary noise in an office is well worthy of consideration.

There are, however, certain kinds of businesses where the decentralized method is very much better adapted to the needs of the concern or where it is desirable to centralize certain office activities and decentralize others. For example, the function of mailing is invariably centralized, while stenographic service is frequently decentralized. Again, certain departments or executives may maintain their own files, while others of the same company file all their material in the central files. No rule can be made as to which method to use, for each case must be decided according to its particular needs and local conditions.

Accounting Division.—The chief accountant, as head of the accounting division, is responsible for the proper keeping of accounting records and for the preparation of all reports and statements based on these records. Performance of this function requires that there be prepared a classification of accounts and a system of records which will provide for the proper analysis, classification and summary of the information contained in the account records. This is to enable him to prepare reports which contain only the essential facts, and which present them in such a form that they are readily understandable.

The accounting division is organized in sections, each section being responsible for the function or functions assigned to it. Thus, there may be a general ledger section, a billing section, an accounts payable section, an accounts receivable section, and so on, the number of sections and the duties performed by each depending upon the volume and nature of the transactions which are to be performed. While the scope of this book does not permit of a discussion of the mechanism of accounting, it is essential that the business man have a fundamental knowledge of accounting principles and procedures. This point can hardly be overestimated. The executive should know what information he needs to aid him in control, he should be able to properly express his needs to the accounting division so that they may furnish him with the necessary data, and, when furnished, he should be able to properly interpret the various statements and reports so as to visualize the progress and tendencies of the business as a whole, or of the department, as the case may be. One of the outstanding features of modern business is the growing appreciation of the value of the accounting function in carrying on business activity and the necessity for a good working knowledge of accounting on the part of the management.

Cost Accounting Division.—Cost accounting is the accounting for units. The cost accounting division is responsible for getting out reports which will show the cost of all elements which enter into the final cost of the product. In organizing the cost division, provision should be made for allocation of costs, order costs, department costs, cost analysis, payroll and monthly costs. The cost accountant, who is head of the cost accounting division, should work in close cooperation with the operating executives to formulate an adequate

cost system which will conform to accounting technique and, at the same time, will meet the particular needs of the manager and other executives for whom costs are being determined. The prime object of cost finding is not merely to show where money has been spent but rather to provide data which will facilitate control, data which will bring out weaknesses and failure in operation and give the executive the information he needs in planning for the reduction of costs and an increase in operating efficiency. Cost accounting systems have been aptly compared to clothes. They may be beautiful and expensive, but they are of no use unless they fit. Each concern has its own cost accounting problems, and the most effective system is the one that is best adapted to the peculiarities of the concern in question. Choosing the right cost system is a difficult problem. Even in the same industry, the same cost system will not fit all or even any two plants. The cost system may be basically the same for all plants within an industry, but the system must be remodeled to suit individual conditions and the routine of operation of the cost system will likewise differ.

A cost system must cover all elements of cost—materials, labor, and expense or overhead. In a process plant the elements of cost are assembled by processes. In a job order concern, costs are computed for each job; the total cost divided by the number of pieces produced on a job gives the cost per piece. Actual costs are compiled on cost sheets as soon as operations are completed. The record of expenditures incurred for materials is obtained from material requisitions, the labor costs from the time or work tickets, the manufacturing expense or overhead, which covers items of general character which cannot be directly allocated to a particular job (depreciation of machinery, power consumed, rental, general supervision, etc.), can be computed in one of a number of ways. Space does not permit of a detailed discussion of methods for overhead. The method of apportionment to employ is the one that, for the particular plant in question, will give as correct as possible a distribution of these general expenses, and yet does not entail undue clerical expense. The following are some of the more common methods employed in burden distribution:

1. *Labor Hours.* Under the labor-hour or man-hour method, burden is distributed in direct proportion to the number of hours of direct labor expended. For example, if the total burden for a given

period is $7,000 and the total number of hours worked is 10,000 hours, a rate of 70 cents per hour is applied as burden for each hour expended on a job. The burden expense for a job requiring 100 hours of direct labor in this case would be $70.

2. *Direct Labor Cost.* Burden is distributed under this method in proportion to the cost of direct labor expended. For example, if for a given period the burden is $9,000 and the cost of direct labor $6,000, each $1.00 of direct labor would carry a $1.50 of burden. A job with a direct labor cost of $1,000 would then carry a burden cost of $1,500.

3. *Machine-Hour Rate.* Under the machine-hour rate method the total expense of operating a machine in a given length of time is divided by the number of hours the machine will normally be in use. This gives the expense rate for operating that particular machine. A given order is then charged at this hourly expense rate for the number of hours the machine is used for that order.

4. *Production Center Method.* This method is similar to the machine-hour rate, except that the rate for a production center is used as a basis rather than the rate for a machine. Each department is divided into one or more production centers with facilities for producing a given class of work. The production center may be a single machine or a group of machines of the same kind, a workplace where a single workman performs a prescribed task, or the workplace where a number of workmen all do the same thing.

Comparison of Standard and Actual Costs.—As Webster Robinson [4] clearly puts it, "If costs are to afford a satisfactory means of control, they themselves must be controlled. Herein lies the necessity for the development of standards of costs, or, as commonly called, standard costs." Standard costs necessitate the standardization of operations. If the character of the work done and the methods and means employed in doing the work vary, comparison of actual costs with standard costs will not give a true test of operating efficiency. A detailed study must be made of each operation for which standard costs are to be set. After necessary changes and improvements have been made, the work must be standardized and standard practice instructions issued, so that the resultant work will be uniform. The standard costs then set will be indicative of what actual

[4] Webster Robinson, Fundamentals of Business Organization. McGraw-Hill Book Co.

costs should be. With changes in the character of work, working conditions or methods, standard costs should be changed to conform with the new conditions.

Judgment must be used in the determination of standard costs. While it is desirable to have the standards represent ideal conditions, it is not always advisable to have them do so. If the standards are set too high at the beginning, the actual costs may be so far different from them as to discourage those who undertake the task of cost reduction. If, on the contrary, they are not set high enough they may be so easy of attainment as to encourage a spirit of self-satisfaction which will destroy the incentive to greater accomplishment. Where there is a wide divergence between actual costs and the standards, it is sometimes advisable to use a series of successive standards, starting below the true standard and revising them as the actual costs are brought nearer to the desired amounts.[5]

By comparison of standard and actual costs, discrepancies can be noted and the cause corrected. An adequate cost system gives the cost and profit and loss on each article produced, the expenditures of each department and the profit or loss sustained from the operation of each department.

Cost reports must be of current periods if they are to serve as an efficient tool of management. They must be accurate and gotten out promptly so they can show to management not only conditions as they are, but by comparison with standard costs and costs of other periods indicate trends, so that necessary steps can be taken to meet changing conditions.

Uniform Cost Accounting in Trade Associations.—The Chamber of Commerce of the United States, through its Fabricated Production Department, has done notable work in assisting its members in dealing with problems of common interest. It serves to bring together those interested in a given problem, and by interchange of experience and expert advice, serves to have them reach a satisfactory conclusion. Some of the most valuable work done has been along the lines of uniform cost accounting in trade associations. The following discussion is an extract from "Uniform Cost Accounting in Trade Associations," a booklet issued by the Chamber of Commerce:

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[5] W. B. Lawrence, Cost Accounting, p. 376.

Uniform Cost Accounting Defined. Uniform cost accounting comprises a set of principles and in some cases of accounting methods which, when incorporated in the accounting systems of the individual members in an industry, will result in obtaining cost figures by the individual members of the industry which will be on a comparable basis. Uniform cost accounting does not mean the preparation of average or standard cost figures for the industry, nor the inclusion in costs of predetermined or fixed elements of cost.

Each industry has its peculiar accounting problems just as it has its peculiar problems of production and of distribution. The problems of the shipbuilder are different from those of the cotton finisher; the stove manufacturer has little in common with the pickle packer. In one industry the cost of material may require the closest cost determination; in another, overhead expenses must be most carefully accounted for. Again, in such an industry as the electrical industry the accounting problem may be concerned with the costs of thousands of small items, while in the cement or brick industries there are just a few staple products. In the chemical industries, for example, the accounting for by-products is important. So it is that each industry has its own peculiarities in cost accounting.

It is quite possible, however, in any one industry to develop cost accounting technique that will result in the figuring of costs by the members individually on a comparable basis. It will give each manufacturer in the industry assurance that all other manufacturers in the same line have included the same items in their costs; that their businesses have been departmentalized in substantially the same way; that there is a common understanding of overhead or burden; that there is a tie-up of the financial and cost records; there is a control of raw material, and so on. In other words, those differences in cost between the members of the industry, which are bound to exist, are due to different efficiencies in management and to economic reasons, and not because of a lack of cost knowledge.

Uniform cost accounting is concerned solely with fundamentals. In the system of the individual manufacturer, there is wide scope and latitude for originality in office methods and accommodation to peculiar accounting requirements; hence, uniform cost accounting is not comprised in a rigid classification of accounts.

Advantages of Uniform Cost Accounting. Among the many advantages offered, uniform cost accounting:

1. Provides the "one best way" known to the industry to figure costs (although cost accounting is a progressive science and provision should be made for keeping the uniform methods up-to-date), thereby eliminating

expensive experimentation by the members of the industry individually and independently.

2. Results in a better informed competition within the industry.

3. Enables the industry instantly to place facts before regulatory bodies.

4. Inspires confidence in the public that selling prices are established by producers who have full knowledge of the costs of the articles offered for sale.

5. Tends to make the manufacturer, who otherwise would fail to see the advantages of good cost accounting, convinced of the desirability of adopting the method which his competitors are successfully using.

6. Reveals lines of individual products which have been marketed on an unprofitable basis.

7. Provides, in addition to the above specific reason, all of the valuable features of good cost accounting generally, among which are the following:

(a) Shows the danger line below which goods cannot be sold at a profit, thus serving as an insurer of profits.

(b) Acts as a guide to the value, efficiency, and waste of workers, machines, methods, operations, and entire plants.

(c) Provides a reliable guide and basis for estimating the cost of prospective business.

(d) Furnishes current reports for comparing major cost items with standards which are predetermined and thereby measures and increases operating efficiency.

(e) Establishes a standard manual of accounting practice so that if your cost clerk, bookkeeper, or accountant leaves you, his successor will find a system the operation of which has been fully and completely developed.

Credit and Collection Division.—The function of the credit and collection division is twofold: first, investigates and passes upon credit rating or standing of every charge customer; second, it takes such steps as are necessary in order to obtain the payment by customers of their bills when they are due.

The credit manager, as head of his division, should work in close cooperation with the sales department, so that sales can increase but at the same time losses from bad debts can be kept within reason. He should also work in close cooperation with the treasurer, as the amount of credit extended and the terms given influence to a considerable extent the amount of working capital required. For this

reason, the credit and collection function is frequently placed under the treasurer. There must be close cooperation between the accounting division and the credit and collection division to assure effective control. Prompt posting of sales and incoming payment is as much in the interest of the credit and collection division as that of the accounting division.

Definite policies in regard to credit and collection should be laid down for the guidance of the credit manager in the operation of his division, allowing him, however, a certain freedom of action within definite limits. Credit extension cannot be made a matter of mere routine, nor can effective collection be secured through a system of form letters no matter how elaborate. After a certain point, individuality of treatment brings better results. An extension of time or even a reasonable amount of assistance may be needed in a case of collection where the customer's position is basically sound but where he is temporarily embarrassed. In another case, frequent dunning is the proper treatment. In the first case, through its helpful attitude, the company frequently secures a customer for life; in the latter case, payment is eventually secured through persistence, whereas otherwise the account would have had to be written off as a loss.

To successfully qualify for his position, the credit manager must be tactful, yet firm. He must be able to limit the credit of a customer, but so inform him as not to appear to make any reflection on the customer's credit standing. At the same time he must be firm so as to command respect and have it known that he means what he says. The credit manager must be a good judge of human nature and a student of practical economics, alert to changing times and the need of keeping the policies of his division in tune with the times. In addition, he must have the ability to so organize and manage his division that he has at all times full control. This he can only do through the aid of control records which will give to him at all times the status of operation of his division, the percentage of outstanding accounts, and exact knowledge as to how good or how bad credit conditions are for his particular concern.

Statistical Division.—In concerns where there is a centralized statistical division, the statistical division arranges, analyzes and classifies needed information from both outside and inside sources, putting the information required in such a form as to be of greatest

value for the purpose for which it is needed. The information may be relevant to materials used, to products, to markets or any other subject for which information is desired. The centralization of statistics brings with it the advantages derived from specialization and at the same time relieves other departments and divisions from collecting necessary information, and so leaves them free for the performance of their own function.

CHAPTER XII

SALES DEPARTMENT

The Problem of Distribution.—One of the big problems in industry today is that of distribution—of disposal of goods produced, at a suitable profit. The application of scientific methods in production with its tremendous increase in production facilities, the ever-increasing variety of products offered for sale, and the keenness of present-day competition, place emphasis in industry on the salesman rather than on the production man as it has been in the past. Competition is vital to business development. It is under the stimulus of competition that the wits of the business man are brought fully into play, with the result that products are improved, service is perfected and markets are broadened. The value received in the present motor car and its wide range of usefulness are due primarily to the stress of competition which requires of each motor car manufacturer, in order to survive, an analytical study of his product and that of his competitors, of trade channels and of new and old markets. Similarly, with all lines of industry, competition brings with it advantages. But competition brings advantages only to those manufacturers who keep abreast of the times and study how best to meet intelligently the competition they encounter.

Each line of industry, in fact, each business concern, presents its own problems of distribution. It is doubtful whether sales can ever be measured and controlled as can production. Many of the factors in sales cannot be measured as can the output of a machine. Sales involve more of the human element than does any other branch of industry and the success of sales depends to a marked degree upon the individuality of the persons involved. It has been recognized, however, that there are certain fundamentals and tendencies the understanding of which will do much toward solving the problems of distribution for the individual concern.

Scope of Activities of the Sales Department.—The work of the sales department exercises important influence upon the activities

of all of the other departments of a business. In a broad sense, the field of the sales department may be construed to include the selection of the proper channels of distribution, advertising and sales promotion work, as well as the selection and training of salesmen and the actual selling of goods. Figure 32 shows a chart of the organization of the sales department when such functions are included. The use of the proper technique of sales and advertising is a very important factor in the successful operation of a business. In this discussion, however, the sales department and its work will be considered from an administrative standpoint, rather than that of operating technique.

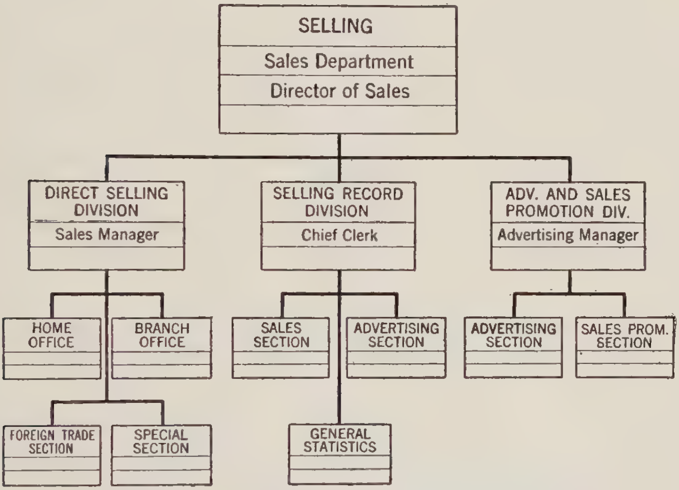

Figure 32. Organization of Sales Department

The Director of Sales.—The main function of the director of sales is so to conduct the affairs of his department that sales effort is coordinated with the effort of the manufacturing and engineering departments, due consideration being given to the financial condition of the company.

In order to take care of this function, the director of sales must be responsible for certain specific duties, among them the following:

1. In cooperation with the general manager decide upon: (a) the sales channels to be used in the distribution of the product; (b) the territory to be covered.

2. Coordinate the activities of and have general supervision over advertising, sales promotion, direct selling and selling record control divisions.

3. Check the cost of making sales and use every effort to reduce sales costs.

4. Keep in close touch with the activities of other departments. (a) The director of sales should work in close harmony with the treasurer, as ordinarily the income of the company is derived from sales and, conversely, sales plans depend to a considerable extent upon the financial condition of the company. (b) He should work in close cooperation with the manufacturing department in an effort to balance sales and production. (c) The director of sales, through his sales manager, should work with the credit manager to the end that while sales increase the loss from bad debts will be held down. (d) He should cooperate with the engineering department suggesting new products or allied fields which the company can enter with profit, or improvements on regular products to meet competition or the demands of the market. The director of sales also should pass upon the practicability of all new products from a selling standpoint and the market absorption of them before it is finally decided to manufacture them.

5. Prepare price lists and a scale of discounts. These must be approved, however, by the general manager before they can become effective.

6. Analyze the sales outlook as reflected in reports of sales volume, reports of stock turnover and loss and gain on important items, reports of competition met, general market conditions, etc., and make suitable reports and recommendations to the general manager.

Product Analysis.—The selling problem covers more than the actual selling of goods—it involves a study of the product. If a machine, it must be analyzed as to its efficiency and economy, its simplicity of operation, its durability, the service required and the ease of installation, of making repairs and adjustments, and any other items which have a bearing upon initial sales and repeat orders. If an attachment or a unit is to be used in an assembly, it must be analyzed to see if it is fully perfected so that it will fit into the scheme of operation into which it is to be placed. The product analysis further includes such questions as: If due to any cause the

present demand for the product ceased, is there another market into which it could be placed? What are the needs of the present consumer of this and similar products? What type of product, and at what price? What special features are desired? The answers to these latter questions show what might be sold if produced. To solve these problems requires the cooperation of the sales department with the engineering department and the manufacturing department.

A study of the product from the standpoint of lost sales and causes frequently points out possible changes or simplifications in design to give the product a wider use or to reduce the cost of manufacture and hence permit a reduction in price and increased sales. Again, a study of the product by the sales department may indicate new lines to be added to make the present line complete, thus facilitating sales by being able to offer a complete line.

Market Analysis.—Those executives who are best meeting competition are those who base their decisions upon knowledge rather than impressions and conjectures. The modern sales manager uses scientific analysis in the place of guesswork, commercial research into buyers' wants and habits, and intelligent appraisal of market possibilities in the place of intuition and hunches. As market conditions naturally affect sales policies and sales to a greater extent than any other business condition, the alert sales manager determines sales possibilities through a detailed study of the territory he is considering entering. The possibilities of such an analysis, if done properly and thoroughly, are almost limitless. It has been said that a market analysis made with due regard to the governing factors enables the manufacturer in that field to tell almost to a dollar how big a slice of the total business available he should get as his share, and how to go about getting it.[1]

The procedure to be followed in a market analysis varies with the product for the selling of which the analysis is to be made. In the case of staple articles such as sugar, coffee, tea and bread, the population of each city and town is ascertained. Demand with staple articles is practically fixed. Their consumption increases with population and cannot be artificially stimulated to any perceptible extent over any length of time. It is then a question of finding out the con-

[1] Roland G. E. Ullman, *Management and Administration*, April, 1925, p. 361.

sumption per family to determine the total volume of sales for that commodity. The next step is to find out in what cities, towns or sections competition is weak and if conditions warrant sales effort being expanded. To determine this with any degree of accuracy, it should be known what competitive products are being sold in that territory, to whom they are being sold, in what quantity, at what price, by what methods, and what proportion of the buying capacity of the territory is so covered.

Results of Analysis.—In the case of electrical devices and appliances such as vacuum cleaners, electric washing machines, electric heaters, etc., the question would be to determine the number of users of electricity. A certain town may have quite a large population, but if gas is used in place of electricity, that town would not be a good market for electrical devices. Climate is also a factor to be considered. A manufacturer of rubber goods would find little market for his product in a section with a dry climate, such as is found in Arizona. The field for commercial purchases, such as office furniture, adding machines, typewriters, etc., would be narrowed down to commercial buyers, a very small number when compared with consumer purchasers.

When a market analysis is being made for a product purchased only by industrial plants, such as milling machines, lathes and grinders, the field is still further narrowed. If the product is a highly specialized machine, the problem narrows down to finding out what manufacturing processes require the use of that machine in the process of manufacture. The next step is to find out the name of all manufacturers using that process, and of all others who might profitably change their process and adopt such a process as would utilize the machine. The next is to study each prospective customer so found, the machines now in use, their advantages and disadvantages, and the general plant conditions. One manufacturer found on making such an analysis that his machine, which in a very restricted field had with replacements and repair parts netted him but a fair return on his money, could be used in one of the large industries which would enormously increase his sales possibilities. The new prospects so found were equally pleased as the use of the machine very materially reduced the labor required and length of time in process. They had simply never heard of the specialized machine, due to its very

limited use, and the manufacturer of the machine, until he had the analysis made, had never realized its possibilities.

Information required for a market analysis can be secured from a variety of sources: from daily papers, financial journals, trade papers, the reports of trade associations, the monthly bulletins of the Federal Reserve Board, publications of the United States Department of Commerce, crop statistics, building permits and many others. In some instances the questionnaire method is used successfully; in others, representatives are sent into the territory in question to get information at first hand. Regardless of the method used in gaining the information the investigation should be a thorough one, as the superficial investigation frequently does more harm than the lack of one could possibly do. After the information is gathered, the facts must be intelligently studied and analyzed, as they are valueless of themselves. Their worth lies in their application, in putting them to use to increase profit.

Estimates Must Be Revised.—A market analysis once made, no matter how accurate, will not remain indefinitely a true estimate of the capacity of that market to absorb a given product. Estimates of market absorption must be revised to meet changed conditions. Salesmen's reports, reports of competition met, statistics as to the condition of the dominant industries in that section, statistics as to crop failures, and many others, any or all of them may indicate the need for a revision of the analysis previously made. The sales manager needs to know of each territory its value to his company and whether it is worth developing to any greater extent. He needs to know where he is getting business, where he is losing business, and why, where he is outselling his competitors, where his competitors are outselling him, and why, who are buying his product, and why they are buying it. The answer to the last question very frequently brings out new features to advertise.

One manufacturer who was meeting but fair success with his product found upon questioning one of his dealers, a new use to which his product was being put, that when advertised more than doubled his former sales. The information derived from a market analysis is frequently surprising. One concern that had very enthusiastically entered the field of national distribution found after a couple of years that, while their volume of sales and gross returns

were large, their net profits were alarmingly small. A market analysis showed that their sales effort might better be concentrated within half of its territories and the buying power of these territories fully developed. After such action was taken gross sales fell off 35%, but net profits rose from $350,000 to $675,000 a year. Again, a company may find that they are paying too much attention to a few large customers and too little to trade in general. We are all familiar with concerns where the loss of a single large customer made a big hole in sales and revealed their condition as being anything but secure as a result. Steady increase in number of customers and well-balanced distribution are essential for permanency. A thorough market analysis shows what proportion of the sales is due to a few large buyers who may or may not be permanent, and what proportion comes from regular customers whose future orders can be relied upon.

Channels of Distribution.—Every manufacturer is confronted with the problem of how best to get his products to the consumer. The class of product and the volume produced are governing factors. It may be more efficient and economical in one case to sell direct to the consumer by mail or by salesman, and in another case it may be best to dispose of the goods produced through the medium of middlemen. There are a variety of trade channels, each of which has advantages in particular instances. The three principal methods of distribution are here briefly discussed. Other trade channels are in reality merely a variation or combination of one or more of these more usual methods.

1. Product to Consumer.—Manufacturers of high grade specialties such as cash registers, adding machines, etc., producers of steel, machine tools, railway rolling stock, etc., cases where the average sale is large, have found it of advantage to sell direct to the consumer, although they at times sell through agents as well. The Fuller Brush Company, the Real Silk Hosiery Company and others selling such articles of common use as brushes and hosiery have found selling direct to the consumer through salesmen very effective and have disposed of millions of dollars worth of products in this way.

2. Producer to Retailer to Consumer.—The retailer buys the goods from the producer and resells at whatever profit he can secure. The retailer runs the risk of not being able to resell the goods pur-

chased and must be paid for assuming this risk as well as for the cost of his services. This on the surface would appear to unduly raise the price which the consumer must pay. In reality, however, in many cases the cost added by the retailer would be less than the proportional cost of maintenance of a sufficiently large sales organization to sell direct to the consumer. By selling to the retailer the manufacturer reduces not only the number of salesmen required, but in addition he reduces the number of credit risks he must assume, as credit standing of the few retailers in comparison with the number of consumers is more readily and more accurately found out. Likewise, he is relieved of the maintenance of a large clerical force, of the trouble and expense of packing and shipping in many small lots, of considerable transportation charges, in some instances warehouse charges and the many other extra efforts and expenses incident to the sale of a large number of small orders.

3. Producer to Jobber or Wholesaler to Retailer to Consumer.—The jobber or wholesaler buys in large quantities direct from the producer and sells in smaller quantities to the retailer. The purchase of the average retailer in dollars is small, especially in regard to staple products. The jobber sells many articles, the products of a number of manufacturers. His salesman can call the attention of the retailer at the same time to the products of a number of manufacturers, hence his selling cost per article is low. The wholesaler is, therefore, able to bring the attention of the manufacturer's product to a much larger number of retailers at less cost than would be involved if the manufacturer tried to distribute the goods direct to the retailer by salesmen. Where prices are close and profit is governed by volume, selling direct to the consumer or even to the retailer would be too expensive.

In such cases by selling through the jobber or wholesaler, all of the advantages listed above under the producer to retailer to consumer method are even more pronounced here, as the number of orders is smaller and the volume sold on a single order is larger. For the retailer, buying through jobbers holds many advantages; he is able to buy in smaller quantities, therefore tying up less capital in stock; the wholesaler usually has a warehouse located at a convenient place for his customers and therefore the retailer can secure more prompt deliveries; he requires less storage space; he can carry a greater va-

riety, therefore catering to a wider range of customers; his attention is called by the jobber's salesman to the products of several manufacturers rather than one, so that he can compare the merits of each and select the product that he feels will best fit his customers' needs. For these and other reasons, this third method of distribution is the channel of trade through which most manufactured articles pass, for while it creates a wider gap between the price which the producer realizes and that which the consumer pays, it is in the average case the most economical method of distribution of products.

4. Combinations of Methods.—Manufacturers frequently use several methods of distribution, either a combination of the basic methods just described or variations of them. Some have a list price for all buyers, with a scale of discounts based upon the class sold to or the quantity purchased. In this way they may sell to the chain stores, because of large volume, at a greater discount than they would to the jobber. Some of the large producers recently have experimented with various combinations of sales channels with the object of reducing the number of middlemen, brokers, agents and commission men which custom has demanded in the past. With demand for his product created through extensive advertising, the manufacturer in some instances may sell direct to the retailer, the retailer being anxious to handle the goods, due to the demand created, many persons feeling the superiority of and insisting upon nationally advertised goods. Some manufacturers distribute their products through controlled but separately incorporated sales agencies, thereby assuming more of the marketing functions. Some sell direct to large consumers or dealers in large cities, but in the small cities and rural districts sell through the jobber to retailer to consumer channel. Back of all the shifting from one trade channel to another is the endeavor to eliminate some of the middlemen and to reduce the cost of distribution.

Synchronizing Sales and Production.—Close cooperation between the sales and production departments is essential if maximum profits are to be earned and the goodwill of customers is to be retained. Only too frequently instead of this essential cooperation a conflict of interest arises between the two departments, with resultant effect on profits and customer goodwill. Where such a condition is found, it is due to the lack of a sympathetic understanding of each

other's problems and requirements. Conflict frequently arises due to the sales department's unduly zealous desire to meet the customer's wishes even to the point of catering to whims and fancies. A variation from the standard product to give the customer a product made especially for him may be a clever talking point, but at the same time it may cause a costly interruption in the production schedule and necessitate new set-ups for the one small run. Again, a rush order may accommodate a customer but at the cost of considerable inconvenience, extra labor and other expense on the part of the manufacturing department.

On the other hand, the manufacturing department frequently does its share in keeping up friction with the sales department by ignoring promised delivery dates and not fully meeting specifications as set forth in the orders. Production men sometimes fail to realize that the salesmen at times must meet the apparently unreasonable requests of certain worthwhile customers. Friction can be ironed out, mutual understanding and cooperation fostered through carefully arranged conferences between representatives of the sales and manufacturing departments. The heads of the two departments should select as the representatives of their departments at these conferences men who can be relied upon to discuss problems fairly and reasonably, men not overly cautious or overly optimistic—in other words, men who base their decisions upon facts rather than emotion. In such conferences problems common to both departments can be discussed in the light of their application to each and a solution found that will work to mutual advantage.

Information the Sales Manager Needs.—The manufacturing department expects the sales department to sell a sufficient volume that will reduce the cost of production to the lowest point. In turn the sales department can rightly expect to be given reliable figures to base their calculations upon. The head of the sales department will want to know the volume of sales necessary to "break even"; that is, the point at which neither a profit nor a loss is incurred but all fixed charges are taken care of. He will want to know what net return would be made if the plant were operating at full capacity. He will want to know the sales volume required to earn a reasonable profit on the investment. This information he will require for each product or line sold. The information should be given to him

not only in units of products but in dollars and cents. It is one thing to be told that the plant is capable of producing an additional 5,000 units per month and that the company is losing money at the present rate. It carries far more weight to be told that the company is running at a loss of $5,000 per month and that 2,000 more units must be sold in order to break even. Dollars and cents loss can be appreciated by everyone. The old saying, "Money talks," always holds true.

The head of the sales department should know how much it costs to make and sell the product, for several other reasons. While the selling price is not based arbitrarily upon the cost of making and selling the product, but rather upon the price at which the principal competitors are selling their goods, the head of sales should know how much it costs to manufacture the product so as not to sell below cost, although this is occasionally done on a certain product as a leader or in times of falling off of business to keep the plant going. Likewise, where due to high manufacturing costs the selling price must be placed at a higher figure than that of competitors, the sales department will want to be told why it costs more to manufacture their product and where their product is superior to that of their competitors. Is the additional cost due to better materials being used, higher grade of workmanship, or what? This information the sales department should have in order to be able to explain intelligently to their customers, if asked, the reasons for the difference in price of their goods and that of their competitors.

Points of Cooperation.—Space would not permit of a discussion of all the points on which the sales and manufacturing departments have a common interest, and about which there should be mutual understanding. The following lists briefly a few of the ways in which the departments may cooperate with one another.

1. The sales department can cooperate with the manufacturing department by:

(a) Furnishing an accurate sales estimate upon which to base production schedules. Intelligent cooperation between the sales and manufacturing departments necessitates the use of sales and production budgets. The head of the sales department is responsible for getting out the sales budget. (For a discussion of the subject of budgets see Chapter XXXII.) Briefly, it may be said that the sales

estimate is drawn up based upon the market analysis which shows the sales possibilities of each territory, and taking into consideration records of past sales, sales plans and policies, present business conditions, and future trends, the financial condition of the company and the production capacity of the plant.

(b) Recommending that certain lines be dropped as they are poor sellers.

(c) Suggesting the possibility of adding new lines to make use of unused or unfilled plant capacity.

(d) Recommending increased manufacturing facilities to meet growing demands.

(e) Pushing sales on slow moving finished stock.

(f) Endeavoring to offset seasonal variations and suggesting new lines to be manufactured in off seasons.

(g) Giving notice of delivery requirements far enough in advance that orders will not have to be crowded through the plant, thus interrupting the regular production schedule and increasing cost.

2. The manufacturing department can cooperate with the sales department by:

(a) Giving the sales department information regarding unused plant capacity and equipment, and indicating whether and how this capacity could be profitably used on products outside of the regular line.

(b) Indicating on what particular products sales effort should be stressed, in order to secure balanced volume and ultimate highest returns on the money invested.

(c) Giving the sales department information regarding the product, its manufacture, the materials used, etc., that will aid the sales department in advertising the product and in making sales.

(d) Giving the sales department cost information showing the lines or products upon which greater profit is made and those upon which little or no profit is made or a loss incurred. When the latter products must be carried to complete a line or as a leader, the sales department by being shown accurate cost figures will see the necessity of keeping such sales down to a minimum.

(e) Keeping the sales department informed as to when deliveries can be made and thus preventing loss of customer goodwill through the sales department's making delivery promises which cannot be kept.

(f) Strict adherence to the standard of quality and to the specifications as set forth in orders.

(g) Prompt replacements in case of justifiable complaints on the part of a customer.

The above outlines briefly cover some of the more general ways in which the sales and manufacturing departments can intelligently cooperate one with the other. Where the concern "manufactures to sell," coordination of sales and production activities can be more readily obtained than where the concern "sells to manufacture." When each article produced is a special order, the sales problem becomes a question of selling plant capacity and of having the delivery dates of orders so scheduled that the manufacturing department can plan and carry out a definite balanced production program. This necessitates the closest possible cooperation between the sales and manufacturing departments. The sales department should keep production men fully informed as to market conditions. The factory men should keep the sales department informed as to unused plant capacity, the availability of raw materials and the number and sequence of unfilled orders, so that the salesmen will have an intelligent basis for making delivery promises, cost schedules to provide an accurate basis for estimating on prospective work, and any other information they require.

Sales and Credit.—The director of sales, through his sales manager, should work with the credit manager to the end that, while sales increase, the loss from bad debts will be held down. Credit consideration in many instances must of necessity dictate the terms of sale. Salesmen can be of invaluable help to the credit department by reporting in regard to a doubtful customer, his property resources, the character and probable value of his stock on hand, the volume of business transacted and its character, whether cash or credit, the general appearance of the customer's place of business and other matters which would have a bearing on credit standing. The alert salesman in his conversation with a customer can get a pretty fair idea of the business experience of the management in charge, of the company policies and methods used. All of this information aids the credit division in deciding if credit can be safely extended and how much. The salesman who puts a rosy light about the prospects of a doubtful customer in order to secure credit terms upon which

he can make a sale has the wrong conception of his work. For the good of his company, it is the duty of the head of the sales department to see that his department cooperates in every way with the credit and collection division, and that each fully appreciates the problems and responsibilities of the other.

Cost of Selling.—The average manufacturer has a pretty fair idea of his manufacturing costs, but he rarely has a true conception of what his selling costs are. He ordinarily lumps his selling expense and figures out what per cent this sum is of his total sales. He then takes this fixed per cent of the selling price of an article and calls it the selling expense of that article, apparently not realizing or else disregarding the fact that selling expense varies with the product or line of products sold and the territory in which they are sold. It may cost $50 to make a $5,000 sale to one customer, and $100 to make a similar sale to another. One sale may require one call on the part of the salesman, another sale may be closed only after a half-dozen calls. Again, the sale of a single article of one product may be $500, while on a lower priced article in the same line it may require the sale of ten articles to reach the $500 mark. It can be readily seen, therefore, that for the great majority of concerns the lumping of selling expenses in this manner is not only wrong but very misleading. Many concerns could, if they made an accurate analysis, trace their lack of profits to the fact that it costs far more for them to sell than they realize. Lumping selling expense and using that figure against total sales to determine the cost of selling may be an easy method, but it is also wrong. If the total selling expense is $150,000 and total sales are $1,000,000, it takes but a minute to figure that $150,000 is 15% of $1,000,000, but what real value is such a figure when obtained? It gives no indication of whether a territory is being sold at a profit or a loss, whether a salesman is an asset to the company due to his volume of sales or a liability due to his excessive expenses, and the fact that the territory he sells to is a rich field, yet even at the present volume is but half sold, and that the easy half.

Determining accurate selling costs is a difficult problem which requires much study of the particular business, its product or line of products, its markets and sales methods. The factors involved in such a study are so different and of so largely an intangible character that it is a much more difficult matter to obtain accurate selling costs

than it is to secure accurate manufacturing costs. Nevertheless, it can be done and should be done if maximum profits are to be secured. Frequently, the difficulty in securing selling costs is more than offset by the knowledge gained from the necessary study of conditions. The determination of sales costs is a study in itself. All that we can hope to do here is to emphasize the value of knowing true selling costs, to indicate a few of the items which go to make up total selling expense and to touch lightly upon the subject of the actual compilation.

Selling Expense.—Selling expense includes more than the cost of the salesman who actually makes the sale, it includes all items of cost that directly or indirectly aid in the distribution of the product. Thus the cost of advertising, of maintenance of the home and branch sales offices, the salary and expense account of salesmen and many other items which aid directly or indirectly in selling, all go to make up selling expense.

The selling process commences when the finished goods are turned over to the sales department in a salable condition, and it ends when the goods pass from the possession of the company in response to a sales order. The following steps are involved in this process: (1) storage of finished product; (2) bringing of the goods to the attention of prospective customers; (3) the procurement of sales orders; and (4) delivery of the goods to the buyer or transportation company. The cost of the selling process constitutes selling expense.[2]

Computing Selling Costs.—There is no one method of computing selling costs that is applicable to all lines of industry or even to all businesses in the same industry. In any method used, the object is primarily to determine some unit cost to be used as a standard by which to judge results, both the operating efficiency of the individual salesmen and the variations in selling cost from month to month. In developing such a standard of selling costs it is necessary to consider each class of expense separately. How far to go in computing selling costs is a matter for the individual concern to decide. There is probably as much danger in carrying the allocation of costs too far, as there is in not carrying it far enough. If carried too far the value of the allocation may not equal the cost involved in the allocation. In some instances the cost of selling a line may be determined it being difficult, if not in many cases impossible, to determine the

[2] James O. McKinsey, Managerial Accounting, p. 334. Univ. of Chicago Press.

cost of selling each item of an entire line, due to the fact that the same salesman carries the entire line and frequently sells several items on one order and at the same call.

One of the major difficulties encountered in determining the cost of selling is the fact that there are, in practically every business, conspicuously high cost territories and others correspondingly low. The low cost territory, however, in many instances will show a proportionately low volume of sales. Low selling costs are not necessarily an indication of sales efficiency any more than high expense necessarily means high sales cost. Many concerns could materially increase their sales volume and ultimate profits, if they were willing to incur the necessary selling expense. Likewise, there are some territories where with little effort large volume of sales results, due to the territory being one in which the line of products is in demand and the customers more accessible. Other territories require considerable educational work to acquaint prospective customers with the line, and the effort expended does not immediately show in the results obtained. In developing any unit by which to judge selling results, therefore, consideration should be given not only to the number of units sold but also to the effort expended.

In some concerns, the salesman's cost per call proves to be a desirable unit cost, a standard cost per call being established for each territory and revised from time to time as changing conditions require. Naturally, in territories where there are many prospects the cost per call will be lower than where there are few. The sales possibilities of the territory as shown by a market analysis, the mode of traveling, the distance between prospective customers, all have a bearing upon the number of calls that can be made and the normal cost per call.

CHAPTER XIII

SALES DEPARTMENT (Continued)

ADVERTISING—SALES PROMOTION—SALES—RECORDS

Organization of the Sales Department.—In organizing his department, the director of sales breaks down his work into main groups of sub-functions. He then selects suitable men to be in charge of these divisions and delegates to them the necessary authority and responsibility. The main sub-functions are direct selling, sales promotion and advertising, these being held together and made more effective by the function of sales record control.

Advertising and Sales Promotion Division

With production of goods on the present scale, the manufacturer must find some way of reaching a proportionately large number of consumers. This cannot be accomplished by the mere addition of salesmen alone. Where a sales force may reach hundreds of prospective customers, output in many plants demands that thousands be reached and in some cases hundreds of thousands. This can only be done through the medium of advertising. It is estimated that one of our well-known popular-priced magazines is read by over 5,000,000 persons weekly. It can be readily seen that for articles of everyday use advertising in such a medium would bring the product to the attention of a vastly greater number than could any sales force of practical size, and at infinitely less cost. In fact, a concern that manufactures one of our best known tooth pastes and numbers its distribution in millions, sells entirely through the medium of advertising alone.

Advertising—Definition and Purpose.—Broadly speaking, advertising is a phase of salesmanship—the extension to a large group of the necessarily limited field and power of personal salesmanship.

Advertisements in most cases are used to attract attention and arouse interest in an article or service, and thus to pave the way for the salesman. Successful advertising, like everything else in business, demands the use of good common sense. Common sense requires that there be a well-defined purpose back of any outlay of money, and good judgment displayed in its use. The purpose of advertising may be one of several or a combination of reasons. A few of the more important are:

1. To get immediate orders. The value of advertising as a means of distribution of product without the use of salesmen, is evidenced by the millions of dollars' worth of mail orders yearly.
2. To introduce a new product to the general public and give it prestige.
3. To educate the public in the use of the product.
4. To create goodwill. Goodwill, while intangible, may be worth more to a concern than the direct sales obtained through the use of the advertisements.
5. To overcome prejudice.
6. To keep up the demand for standard products by keeping the products before the eyes of the public.
7. To meet competition.

Advertising Policy.—The advertising policy of any concern is determined to a considerable degree by its sales policy. Like the sales policy, it should only be determined after a thorough analysis of the product and the market, and with all due consideration to the financial condition of the company and the amount of money available for publicity. Spasmodic advertising decided upon at the spur of the moment rarely pays. It is the repetition of a fact about the product which the advertisement is to drive home, whether it be quality, price or service, that brings that which is the ultimate aim of all advertising, namely, a steady increase in the volume of sales.

Advertising policy ordinarily takes into consideration:

1. The appropriation for advertising, not only the total annual appropriation, but its distribution and allocation between products: (a) Equally distributed over the year. (b) Appropriation available when asked for by the advertising department. This would be an important factor if adver-

tising plans called for an extensive campaign at certain seasons.

2. The mediums to be employed.
3. The company to care for its own advertising or through an advertising agency. The agency brings with it advantages gained through specialization and volume of work.
4. Character and type of copy. This depends primarily upon the character of the product, and the market to which appeal is made.
5. Scope—local or national.
6. The class to which the advertising is to be directed. (Dealer or consumer or both.)

Advertising Mediums.—Advertising mediums cannot be used indiscriminately. The medium to use is the one that will reach the greatest number of the persons you wish to reach at the lowest cost. Articles of general consumption require mediums which appeal to the general public. The manufacturer of a high grade machine tool, on the other hand, would simply waste money if he advertised through such a medium. He requires a technical journal or some similar medium. Advertising properly done is an effective agency of distribution. Advertising done without regard to the proper ways and means to be employed is just so much money wasted.

It is advisable to test the effectiveness of a certain medium by using it first to a limited degree and comparing the results with that of other mediums given the same test. The result of such a test often shows a wide variation in results secured through even apparently similar mediums. In magazine advertising, such a test is frequently made by what is known as "keying." This may be done in a number of ways. Coupons of different forms may be inserted to be filled out; samples may be given, if applied for to the company, each medium being tested having incorporated in the address a distinguishing department number or letter; or a booklet may be sent upon request, the number of the booklet varying with the medium.

Mediums may be roughly classified into direct and indirect mediums. Direct mediums include anything which is sent direct to the prospective customer. These include form letters, samples, booklets, catalogues, souvenirs, house organs, etc. While direct adver-

tising does not give as wide publicity, it can be made very effective, provided the mailing list used has been compiled with care. Indirect mediums include newspapers, magazines, billboards, window displays and electric signs. After the class of medium is selected, the particular medium within that class best suited for the purpose must be chosen.

Character and Type of Copy.—The character and type of copy depend, primarily, upon the character of the product and the class to which appeal is being made. An advertisement in plain black and white with no illustrations may be effective in a trade paper, where the readers are professional or vocational men who are interested in the information given in the advertisement. In other instances, such a type of copy would have little or no pulling power, a commercially artistic display in color being required in order to attract the class of persons desired; as for example, the effective advertisements for Campbell's soups, showing in color the fresh condition and variety of vegetables used in making the soups. In using illustrations in the copy, however, care must be exercised that the illustration is not so striking as to detract from the product being advertised. An advertising copy, to be effective, must not only catch the eye, but it must create interest in the thing advertised and a desire to obtain the article.

In creating interest, the copywriter must be careful not to exaggerate or mislead. The making of a sale is not the ultimate aim, it is the securing of a satisfied customer. An advertisement that through extravagant claims or misleading statements encourages persons to buy, does more harm than good. Fortunately, advertisements of a questionable nature are decidedly in the minority and are getting more so every day. The better class of magazines and newspapers exclude all such advertising matter from their publications. It is, therefore, a safe rule always to buy advertised trade-marked goods, as the reputation of the manufacturer is back of the goods when so purchased.

Dealer or Consumer Advertising.—In marketing a new product, unless the company is already well established and the quality of its product known, advertising is usually done with the view of interesting the dealer, of convincing him of the merits of the product, and its salability, and the profits he can readily secure if he handles

the new product. In the average retail store, the sale rests to a considerable extent with the salesman. Customers when purchasing in a store which they know is reliable are very likely to take the article recommended by the salesman. The goodwill of the dealer, therefore, is a big factor in distribution. Many of the larger manufacturers, however, concentrate the greater part of their advertising in making an appeal direct to the consumer, feeling in this way that the dealer will be not only willing but anxious to handle the product for which a consumer demand has been created by advertising. An ever increasing volume of retail sales is of trade-mark goods asked for by the purchaser, the salesman in such cases merely playing the part of order taker. Dealers, therefore, are apt to favor products for which the manufacturer has created a demand through advertising, as part of their work has been done for them and sales are more readily made. Advertising to the consumer, however, is expensive, and the manufacturer must look to his costs, as it is not the volume of sales but the ultimate profit on those sales which after all is his first consideration.

The Advertising Manager.—The advertising manager in cooperation with the director of sales and the sales manager, determines the advertising policy subject to the approval of the general manager. As the technique of advertising is quite different from that of selling and requires a specialized knowledge of such matters as copywriting, layout, mediums to be used, etc., it is customary for the head of the sales department to give the advertising manager full authority in his division and to rely upon his judgment in all matters relating to advertising technique.

Coordination of Sales and Advertising.—As selling and advertising have the same objective, that of securing a constantly growing number of satisfied customers, it is essential that there be perfect teamwork between the two divisions covering the respective functions. Advertising serves to interest the dealer, to secure prestige for the company and its products and to create consumer demand. This is all of direct benefit to the sales division. In order to make the work of his division most effective, the advertising manager should be kept fully informed as to all selling plans and the progress of sales. If a sales campaign is to be inaugurated in a certain territory which needs development or in one in which the dealers have become lethargic and indifferent, the advertising manager should be told of it immediately,

and the sales manager and the advertising manager should confer with one another as to how best to make the campaign effectual. The advertising division should lend its support to the sales division at all times and so arrange its advertising program as to help carry out the plans of the sales division. In turn, the sales division should keep the advertising division informed of any changes in its plans or in market conditions.

Sales Promotion.—To supplement the work of selling and advertising, there has been created in a number of concerns a new section called the sales promotion section. The exact duties of such a section cannot be defined so as to suit all cases, as practice differs widely as to the functions to include. Careful sales research and investigation work, however, are usually common to the work of all sales promotion sections. In the majority of concerns there is no separate section of sales promotion work, as such. In most cases, sales promotion work is carried on by the sales or advertising division. Nevertheless, the function of sales promotion exists and the importance of sales promotion work must not be lost sight of. Sales promotion work has been aptly spoken of as the connecting link between advertising and sales.

One of the most important duties of the sales promotion division is to prepare materials to be sent to dealers to stimulate their interest in the products of the company, and to aid them in disposing of the products when bought. Under dealer helps would be included store cards, store and window display material, and descriptive leaflets, blotters, etc., for distribution by the dealer to his customers. The designing, printing, and distribution of dealer helps frequently become quite an item of expense in the course of a year and it is, therefore, the duty of the sales promotion division to see that the dealer makes effective use of them. A seemingly self-evident rule, but one which is disregarded in many cases, is to consult with the dealers as to the kind of material that would be of most use to them. Appeal must be made to the self-interest of the dealer. Much time and money are wasted in preparing material that the dealer has not the space to display or has not the inclination to use, so merely lays it aside and forgets it. Some concerns have found it pays to bring the material personally to the store, to make suggestions as to window displays and even in some cases to arrange an attractive window dis-

play of their line of goods for the dealer. A few concerns have found that charging a nominal sum for their dealer helps has made the dealer appreciate their value, working on the theory that things that are gotten for nothing are rarely appreciated.

Sales Division

Sales Manager's Duties.—The sales manager is in charge of the direct selling function. To be qualified to hold such a position, he must himself be a good salesman with considerable active sales experience; otherwise he cannot fully appreciate and understand the many problems which come up daily in active sales work. He must have executive ability so that he can organize and manage his division. On the one hand, he must be able to inspire his salesmen with confidence in himself and in the company, and with confidence and enthusiasm for the products they are selling. On the other hand, the sales manager must not be too optimistic and visionary. He must be able carefully and calmly to lay selling plans and formulate sales policies, realizing the extent to which the plans of other departments and the success of the business depend upon the efforts and accomplishments of himself and his salesmen.

The sales manager has direct control of such active agencies of sales as local and traveling salesmen, branch agencies and all other sales outlets which the concern has set up to facilitate the distribution of their product. As sales manager he has a voice in the matter of factory products, especially as to the quality and finish and the type of packaging.

Among the principal duties of the sales manager are:

1. Selection and training of salesmen.
2. Devising means of improving the efficiency of his salesmen and to maintain morale.
3. Preparation of and check on sales quotas for each individual salesman or branch sales unit.
4. Charge of all branch offices. Standardization of selling policies and sales record keeping in all branches.
5. Study of possibilities of new selling fields and of more intensive selling in present fields.
6. Check on expenses of salesmen and home and branch offices and strive to reduce selling expense without injury to

sales work. This includes decision as to compensation of salesmen.

7. Scheduling the work of and supporting the salesmen in the field.

Salesmanship.—Every sale made to a buyer that has been hard to sell to is well worth the effort expended, in addition to the advantage gained through the sale, as it strengthens the skill of the salesman. Easy selling lacks interest and becomes order taking. Resistance brings out true salesmanship.

The salesman must have faith in himself, his product and his firm. He must know that his product will do the things he says it will, he must be convinced that his price is right. The true salesman sells his buyer on the real points of the product, he creates in him a desire for the product, he gains his confidence, and then if the price is right, the sale is made. The salesman works for satisfaction, for permanent, lasting relations. This he cannot get by mere price concessions. Frequently the giving of a price concession is recognized as a sign of weakness, and if the order is given, it is with the thought that a further concession might have been secured. The price should be right to begin with. If goods are sold at too great a price concession to secure the order, it will not pay to secure repeat orders at the same price, and if the price is raised the customer feels he is being taken advantage of and will place his order elsewhere.

In sales work, a smile is an asset and a pleasant manner is a big business help, but it is not all. The buyer may enjoy a good joke, but too many jokes or ones of the wrong sort materially take away from the earnestness of the sales talk. As one of our most successful sales managers puts it, "Jokes are an asset if properly used, but a joke should never be told except to drive home a point." The best salesman is not the one who talks most, but he is the one who talks to the point. Many times a salesman talks himself out of a sale. Even in salesmanship there is a great advantage to be gained from being a good listener. The best entertainer is not the best salesman. The salesman is paid to get the business, entertaining where it is needed is only incidental.

Good salesmanship is based on knowledge. The buyer respects the salesman who knows his business. Personality, experience, judgment, knowledge of the product, honest effort and persistence are

essential qualities in salesmanship. As some one aptly put it, the salesman must be "pleasingly persistent." When a salesman has not been able to sell to a certain man or concern, he should analyze the reasons why he was not successful and then go back and try along a different line.

Selection of Salesmen.—Salesmen are the point of contact between the company and the buying public, and represent the company to the customers and prospective customers. It is essential, therefore, to select only those who have a pleasing personality and can get along well with people. An unfortunate selection may result not only in a lack of orders, but of what is of far greater importance the antagonizing of customers and prospective customers and so spoiling what might have been a profitable territory.

Some sales managers attribute the success of their sales force to the fact that they select as their salesmen only those who have had considerable sales experience; others are equally insistent that the successful sales force is the one composed of men who have been taken on by the sales force when young, before they have developed sales habits and trained along the company's own methods. Other concerns will have as salesmen only men promoted from the ranks. Each attempt to prove from their own experience how their method of selection is the one and only correct method. Invariably, they can all point to some instance where they deviated from the rule and failed. The truth is that each uses a method that is successful in their particular case but which might be decidedly unsuccessful in many other cases. In those concerns where the salesmen are promoted from the ranks, it is probably a case where a thorough knowledge of the production end of the business is needed in order to intelligently solicit business. As far as taking on only men of considerable sales experience is concerned, that method in many cases has proved a fallacy, due to the salesmen being so set in their sales habits that they could not drop them and adopt the different method of approach and peculiar technique needed for the new work.

The type of salesman to select depends upon the product to be sold, the class of persons to whom sales are to be made, the business conditions of the time and the territory to be covered. If a new field is to be opened, it may be policy to select what might be termed a "live wire," in other words, a high pressure salesman who, by his

enthusiasm and line of sales talk, can sweep the prospect off his feet and land an order on his first call. Such a man, however, would probably be a failure in a position where he had to cover regularly and thoroughly the same territory and meet only the same customers with little time elapsing between calls. He probably would not be able to stand the routine. He is the type that needs the stimulant of new fields to conquer. Conversely, the routine man who makes a friend of his customer and looks forward to seeing the same person each call ordinarily lacks initiative. He hesitates about calling on new concerns, he does not feel at home among men who are total strangers to him, and so he is not at his best, and his sales talk to them lacks the necessary enthusiasm and persuasiveness needed to open a new account.

Similarly, the selection of the salesman depends upon the class of persons upon whom the salesman is to call. Here must be considered the questions of nationality, education and personal environment. Where the buyers are men of little or only a fair amount of education, they would in many cases resent the call of a polished, highly educated salesman. They would talk freely with and give their orders to men with whom they felt at home, men who were "one of themselves."

Training of Salesmen.—As knowledge of the product and of the sales policies of the company are indispensable to successful salesmanship, no salesman, no matter how extensive his past experience, should be given a territory and sent out to make calls without some preparatory training. The process of training varies greatly, being governed by the past training and experience of the men selected, the character of the product, the facilities at hand and the money available for such training. Many concerns may recognize the benefit to be derived from giving salesmen a course of training under competent instructors, but they may not be financially able to do so.

Salesmen training in the more up-to-date companies is ordinarily done in one of two ways or, as in many instances, by combining them. Under the first method, new salesmen attend for a definite period company training courses. These may include training in the factory, so that the salesman will understand how the product is made, the materials used, the rigidness of inspection, etc., and so be able to give intelligent information and service to the customers, or it may include

carefully planned talks on the subject of the product, its manufacture and use, including demonstrations of sales. In the latter case, the salesman would probably be asked to give a simple, logical and convincing demonstration of the product, bringing out the salient features. In addition, he may be asked to answer a number of objections to the product and its purchase such as may be met in active sales work. This does not mean a memorized demonstration and sales talk which must be used by the salesman in his active work. The demonstration is shown him with the idea of giving him a logical order and a sequence of thought to use as a basis. The salesman is expected to use the words that come naturally to him, and to inject into the demonstration his personality and individuality.

In the second method the salesman is sent out on the road with an experienced salesman to observe his methods of selling. After making a number of calls, the two men together analyze the method of approach and technique used and the reasons they assign for the failure or success of the particular calls made. After a period of observation, the new salesman is given a number of customers or prospects to call upon, the older salesman going with him. At the close of the calls the experienced salesman will discuss the new man's work, and in a spirit of helpfulness but not criticism will point out the mistakes made and give constructive suggestions.

When the salesman leaves the training course for active sales work in a territory assigned to him, he cannot be expected to be 100% efficient. However, he should have the fundamentals he needs and his daily repetition of the correct methods will soon make them his own. If he starts without training and makes mistakes which through lack of supervision are not corrected, he will probably repeat those mistakes until they become fixed bad sales habits.

Sales Quotas.—It is the duty of the sales manager to prepare sales quotas for each salesman based upon the sales possibilities of the respective territory covered. This sets a goal for the salesman to reach, as it states the volume of business he is expected to produce during the ensuing period. In setting a quota, past records of performance are used, but taking into consideration the normal increase that should be expected due to customer goodwill, past development work done in the territory, increase in number and size of industries, etc. In addition must be considered any changes in company policy

which may have an effect on sales. If additional products are to be added to the line or certain present products discontinued, if advertising appropriations are to be curtailed or increased, or the allotment to specific products or territories changed, these and many other policy changes all can rightfully be expected to influence future sales.

In setting a quota, sales estimates are broken down according to products covered. This shows the salesman where sales effort may be most profitably expended and serves to prevent his selling along the lines of least resistance. In addition, the setting of sales quotas by product is of invaluable aid to the production and purchasing departments. We will consider the sales quota here, however, from the standpoint of sales administration only. Its relation to production and to the business as a whole will be covered under the subject of Budgets in Chapter XXXII.

The sales quota serves to stimulate the salesmen to greater effort and acts as an equitable measure by which to gage their efficiency. When volume of sales or total sales in dollars is used as a means of measure, the salesman who has been fortunate enough to secure a fertile territory rates the highest, although another salesman with considerably less volume of sales may have put forth far greater sales effort and may have been of more value to the company, as he has developed an otherwise barren territory.

Checking Performance and Quota.—When a check of actual performance against the quota set shows the salesman is not coming up to the standard set for him, he should immediately have the fact called to his attention. The salesman, knowing that the quota is based upon facts and that figures speak for themselves, appreciates the futility of making excuses and will usually "get down to business" and see that he meets his quota. This is a far more effective method of control than the old haphazard method under which, if the salesman did not sell the volume the sales manager expected, he would call him to the office and "rake him over the coals," in many cases unjustly. The quota not only aids in control, but reduces the rate of labor turnover which is always high under the old method of complaint and protest without basis of facts.

In setting sales quotas some concerns feel it is advisable to set the mark a little beyond what it is expected the salesman can reach, feeling that the higher the aim the greater the effort that will be

expended. They maintain that if the quota is one that the salesman can reach without undue effort, he will take things easy and not exert himself to the full extent of his ability. Other concerns maintain that by setting a goal so high it makes the salesman discouraged, but if a goal is set that he can reach, he will strive his utmost to see how far he can go beyond the figure set, especially if there is provided an additional compensation for exceeding the quota.

Planning and Supporting the Work of Salesmen.—A salesman frequently fails, due not to the lack of salesmanship but to the fact that he has not properly planned and utilized his time. The sales office can materially reduce wasted effort and neglect of customers by planning a route by which the salesman can thoroughly and economically cover his field. Many salesmen have the mistaken idea that they need a large territory. In reality, with few exceptions, it would be far more profitable to cover a more restricted territory and cover it thoroughly. They could then call upon their customers at more frequent intervals and thus become better acquainted with them, and at the same time could reduce their traveling expenses which in many cases are an important item in reducing the profits made on sales. The average salesman can readily be made to appreciate this fact if the sales manager takes the time and effort to explain it to him from the viewpoint of the salesman's self-interest as well as the interest of the company.

Some concerns provide each of their salesmen with a list of customers or prospective customers whom he should call upon within a specified time and the order in which the calls can best be made. All information that the salesman needs in making a call, record of past sales made to the customer, items bought last date of purchase, credit standing, descriptive matter or special data regarding the product which it is felt the customer would be interested in, and any other information that should be of value to the salesman are prepared for him. The salesman is also provided with sales report blanks so designed that with a minimum of clerical work he can give all the information the sales manager needs as to the outcome of the call.

Salesmen as a rule do not care to do any more clerical work than they absolutely have to. They feel they have a grievance against the company if they are expected to do any considerable amount. In many instances the grievance is just, for it is hardly fair to expect a

salesman after a hard day on the road to spend the greater part of his evening in writing up a report to the home office. Yet the sales manager needs first hand information regarding customers and conditions in the sales territories to use as a basis in judging the status of sales and in planning sales campaigns. A little thought spent in devising a suitable form upon which the salesman can make adequate reports without undue clerical effort will more than repay the sales manager, not only in the information so secured but in the elimination of much misunderstanding on the part of the salesmen and the fostering of a better spirit between the home office and the men on the road.

Salesmen, especially if far away from the home office or on a long trip, are likely to get out of touch and go stale or become temperamental and develop a grouch, due to fancied wrongs or some other reason. Herein lies the value of conventions, of sales drives with suitable prizes and other similar means of keeping up the morale of the sales force and of injecting a little bit of wholesome rivalry among the salesmen.

Salesmen's Compensation.—One of the big problems in the average manufacturing concern is that of devising the most effective method of paying salesmen so as to secure their hearty cooperation and best efforts. Where salesmen are paid a straight salary, it is usually found that the company gets just about what it pays for and nothing more. If high-grade salesmen are employed at a large salary they usually can be depended upon to exert their best efforts in the interest of their company, but even they, in many cases, are found to work along the lines of least resistance, making calls on regular customers and neglecting development of new prospects. If average grade salesmen are employed, they are very likely to prove mere order takers unless they have some incentive beyond their straight salary.

If salesmen are paid on a commission basis they frequently develop the idea of being their own masters and are prone to resent guidance from the sales office. Every moment spent in developing new customers, they are likely to feel, is taking away from the commission they might be earning by calling upon their regular trade. If the commission is paid on sales volume, as it ordinarily is, salesmen are inclined to run up sales volume at the expense of profits,

selling those products which sell easiest rather than endeavoring to sell those products upon which a greater margin of profit is derived.

Some concerns pay their salesmen a nominal monthly flat salary with a graduated scale of commissions and bonuses on increasing sales. In doing this it is not unusual to encourage new salesmen by giving them a compensation higher in proportion to their sales than they would normally earn if fully productive. This encourages the new salesman and tends to tide him over that trying period in which he is adjusting himself to the new product he is selling, the selling methods and policies of the company and the new territory he has to cover. Some such arrangement, if carefully planned in justice to both old and new salesmen, will do much to reduce the costly turnover of salesmen who become discouraged when sales in the beginning do not materialize as fast as they feel they should expect, due to the effort expended.

Compensation on Efficiency Basis.—Some progressive concerns have recently developed compensation plans which take into consideration the efficiency of all sales work done. These may include a higher proportional compensation for orders from new customers than for orders from established customers, of certain compensation for reports turned in, for number of calls made, for exceeding the sales quota, for giving certain specified service to customers, and so on. With sufficient thought, such a compensation plan can be worked out to meet the needs of practically any concern. Care must be exercised, however, not to make the plan too complicated. A plan that involves much clerical labor defeats its own purpose as it is too costly to operate and too complicated to meet the approval of the salesmen. The average salesman likes to compute his own salary and commissions, and mistrusts a plan in which he cannot readily tell just what money is coming to him.

To get around this difficulty a method is sometimes used by which each class of sales efforts is accredited a definite number of points and each point has a specific value in dollars and cents. Thus for three hundred dollars worth of sales of one product one point may be accredited to the salesman, while one hundred dollars worth of sales of another product requiring more sales effort, or one upon which a greater profit is made, may also bring one point credit—the point in both cases having the same dollars and cents value. This method

properly worked out is simple in operation and materially reduces clerical effort. It is equitable to all and provides incentive for doing all of the various kinds of work necessary for sales efficiency.

Salesmen's Expenses.—Traveling expenses of salesmen have become one of the big items in the cost of distribution, due to the marked increase within the past few years in transportation rates and hotel charges. Many concerns keep to the old method of requiring their salesmen to turn in a detailed account of expenses on a form provided for the purpose, the company to reimburse the salesman for the expenses incurred. It is then the duty of the sales manager to watch these expense reports and to keep expenses within reason. Just what constitutes a reasonable figure for expenses is frequently a point of contention between the sales manager and his salesmen. The salesman, as he is not paying the bill out of his own pocket, may be unnecessarily free in spending, living and traveling on a scale out of keeping with his position. Or he may pad his expense account by putting in personal expenditures which it is not the part of the company to pay. The sales manager, on the other hand, not appreciating the present-day high cost of traveling and the need for perhaps a little extra comfort after a hard day on the road, may be inclined to cut expenses too sharply. The result is a misunderstanding —with the sales manager feeling the salesman demands luxuries or is not honest with him, and the salesman thinking the sales manager is niggardly. This cannot help but have an unfortunate effect on sales.

To eliminate the possibility of friction over expense accounts, some concerns give their salesmen a fixed expense allowance which is computed to be ample to cover all necessary expenses. The difficulty in such a plan is that a salesman may neglect his own welfare in trying to save a portion of this allowance, thereby lowering his selling efficiency and perhaps detracting from the standing of his company. The salesmen being the representatives of the company, the company is judged to a considerable extent by the appearance and conduct of the salesmen. If a salesman travels in a cheap manner, patronizing second-class hotels and restaurants, the company he represents is likely to get the name of a second-class concern. Similarly, the salesman in shaving his expenses as close as possible frequently puts himself to unnecessary effort and inconvenience, and

as a consequence is not at his best. Such conditions must be guarded against when giving a salesman an expense allowance.

Organization of the Direct Selling Division.—In organizing the sales division it is customary to divide the work according to functions covered, and as shown on the chart in Figure 32 there may be a home office section, a special section, a branch section and a foreign trade section. The divisions of work and the sections required will depend upon the character and volume of the product, the sales channels used and the territory covered. Home office section and the branch office section are self-explanatory.

Special Section.—In some concerns it may be desirable to functionalize selling effort by setting up a special section whose duty it is to handle just one class of trade, such as a section organized to specialize in handling the railroad trade.

Foreign Trade Section.—In selling to foreign markets, the same general principles that apply to domestic trade hold good with certain adaptations. The person in charge of this section should have a thorough knowledge of foreign trade conditions and of business methods as employed in the countries with which trade is to be carried on. Sales work in foreign fields can be conducted either indirectly through commission agents or exclusive local agents, or, if the volume demands, a foreign sales organization can be built up within the company itself and sales made direct through salesmen.

Foreign trade performs invaluable service during periods of dull domestic business. Prices of raw materials are then low and attractive offers can be made to foreign buyers. The trade if established, however, should not be developed for domestic depression periods only. It should be kept up at all times, but pushed harder during depression times, thus serving to stabilize the business and keep the plant running.

Before deciding upon entering the export field, careful analysis should be made to determine whether the product is one that will meet foreign demands and whether the results to be accomplished will be worth the effort to be expended. Among the points that should be considered are:

1. Is there a demand for the product and, if not, can a demand be created without undue effort and expense? The standard of living

abroad, in but very few places, does not compare with the standard of living in the United States. The poor in America enjoy advantages that would be considered luxury to even the fairly well-to-do in many foreign countries. This fact has an important bearing on foreign trade possibilities for many of our products, even those of common domestic consumption.

2. What competition will have to be met? Goods of foreign countries are frequently produced at a lower cost than similar goods in the United States owing to the cheapness of labor abroad. If the product cannot be sold at a figure to assure a fair margin of profit, it would hardly be worth the effort and expense involved in building up export trade.

3. Which of the many foreign markets is most suited for the particular product? Here must be considered the buying power of each country, their buying habits, the cost and adequacy of transportation facilities, credit conditions and facilities, restrictive laws, duties, etc.

Valuable and comprehensive information on all the above points may be secured at a nominal cost from the Bureau of Foreign and Domestic Commerce of the Department of Commerce at Washington, from the Chamber of Commerce of the United States, from the American Manufacturers' Export Association, National Foreign Trade Council, various export trade papers and many other sources. There is an abundance of authentic information available on the possibilities of export trade, and the manufacturer who is considering entering the field would do well to inform himself thoroughly before deciding whether to enter and how, when and where to enter.

Selling Records Division

The selling records division is under the line control of the director of sales and under the functional control of the comptroller. In organizing his division, the chief clerk breaks down the work according to the functions covered and makes the person in charge of each section responsible to him for the work to be done in that section.

Advertising Record Section.—This section keeps the necessary records and gets out the required reports in regard to advertising campaigns, advertising done by competitors, advertising expense

showing comparative costs, advertising results by mediums and any other phase of advertising work. Such records and reports aid the advertising manager in the control of his division, and the director of sales in gaging the efficiency of his advertising division.

Sales Record Section.—The sales record section, as the name implies, keeps the necessary records and gets out the required reports in regard to sales effort and expense. Among the reports required may be reports showing comparison of actual sales with sales standards, both by line and individual product; comparison of sales according to districts; of sales by individual salesmen; sales by lines of business sold to; sales according to selling terms, and so on.

General Statistics Section.—Under this section are included the recapitulation of all statistics, the control of all records and the getting out of all reports needed by the sales department, but which are not included under the work of the advertising record section or the sales record section or furnished by the comptroller's department—for example, reports of finished stock turnover and loss or gain on various items, reports on unprofitable business, the demands of markets by products, and so on.

In other words, it is the function of the selling records division to provide in proper form all information needed for the conduct of the sales department, both the progress of the department itself and its relationship with other departments. To guide and control his department adequately, the head of sales requires knowledge of past and current market conditions and of the status of his salesmen and their territories. Market conditions are continually changing. Information, therefore, must not only be accurate, but up-to-the-minute. For those in charge of sales work to gather the necessary information uses up their mental energy, adds to worries and fear of neglecting or overlooking something of importance and immeasurably detracts from their functioning as executives. To make decisions without a sound basis of knowledge, no matter what the ability of the executive, results in guesswork. This holds true whether the executive be the head of the department or one of his lesser subordinates. One very successful sales manager who apparently conducts his department with a minimum of effort has his reports given to him whenever practicable in the form of graphic charts. The charts showing the

status of the various sales branches are brought up-to-date daily, and permit him to act immediately upon any case that may require his attention. By the use of charts he readily and effectively keeps in touch with all the various phases of sales work, something he could not possibly do in a department the size of his if he had to pore over and study a mass of figures.

CHAPTER XIV

ENGINEERING DEPARTMENT

The Engineer.—Engineering has been a highly important factor in the progress of our country and of civilization itself. Through engineering, machinery has been designed and constructed to take the place of human effort and to eliminate much drudgery. The influence of the engineer with his creed of truth and facts, not guesswork, with his planning of activities and direction of effort, his logical thinking, exactness and analysis are seen everywhere in the control and direction of mechanical and human effort.

Place of the Engineering Department.—The place of the engineering department in an organization depends upon the importance of the engineering function in that particular concern. Where the engineering features of a product and its fabrication are comparatively simple the engineering function is ordinarily taken care of by an engineering division under the control of the director of manufacturing. Where the adequacy of the control of the engineering function is one of the important factors in the ultimate success or failure of the business it is taken care of by an engineering department reporting direct to the general manager. This plan of organization eliminates any undue influence of intervening elements.

It is unfortunate that in many concerns the design of the product is continually being changed to meet the demand of the sales department for new designs as a basis for "sales talk." In other concerns improvement in design is stifled due to the insistence of the production department to keep manufacturing processes sliding along in the same old comfortable routine. With the engineering department as a separate unit under the general manager it is able to carry out its function to the greatest possible advantage to all concerned—to design all products so as to meet the standards of good engineering practice, to facilitate economy of manufacture and, at the same time, have all products up-to-date so as to meet fully the demands of the market.

Function of the Engineering Department.—The engineering function resolves itself into two main sub-functions, namely:

1. Invent, improve and design the product or products to be made and determine the tools to be used in their manufacture.
2. Furnish all necessary data which will facilitate manufacturing and insure that the products will be up to the specifications set.

Invention, Improvement, Design.—Under the first function the engineering department will have to perform the following duties:

1. *Study the Product.* This includes research, experiment and test of the product under field conditions. A study of the product in actual use in the hands of the consumer will frequently show the engineer how by a slight variation in design the product can more fully meet consumer needs. Likewise, a study of used or worn-out products and of records of repair parts called for can show the points of weakness that need correction. In the study and design of the product the engineering department should work in close cooperation with the sales and manufacturing departments. A design may be theoretically perfect but it may be too costly to manufacture or it may not suit consumer demand. Modifications from the theoretically perfect design would, therefore, be necessary. For this reason any design before being accepted and put into production should be subject to the approval of the heads of the sales and manufacturing departments.

The product should be studied from each of the following viewpoints:

(a) As to its use. The product should be continually studied to see whether improvement can be made whereby the product would: (1) be more fully adapted to its present use; (2) meet the demands of a broader field.

(b) As to the advisability of getting out similar or related products. A concern to keep in the first rank must be progressive. The concern which recognizes a growing or coming need and prepares to meet that need has a great advantage over its competitors with less foresight. The Atwater Kent Manufacturing Company owes much of its success in the radio field to the fact that as a maker of electrical

precision instruments it early recognized the importance of the radio and was one of the first concerns to enter the radio manufacturing field.

(c) As to the efficiency of the design. Difficulties should be avoided rather than a solution found to overcome them after they appear. Every part of the design and of the process required in manufacture should be given the fullest possible consideration. Changes made after the product goes into production are costly. A change may result in considerable obsolete stock, in changes in other parts with which the changed part is to be assembled, in the machinery, jigs, fixtures, cutting tools, and other equipment required in manufacturing the parts.

(1) Wasteful in regard to the amount of material required. A slight change in design may bring about a decided saving in material cost due to the new design requiring a smaller amount of material, the use of less expensive materials or possibly the use of more expensive materials, but smaller in quantity.

(2) Clumsy to handle or difficult to manufacture. Parts that are clumsy to handle or difficult to machine greatly increase labor cost. The spare tire carrier for one of the popular make cars was clumsy to handle and difficult to machine. A change in design was made with the result that the machining time was reduced 68%, thus considerably reducing the manufacturing cost, yet the new carrier was just as efficient and as satisfactory in every respect.

(3) Suggestions as to improvements in design or materials used, regardless of the source from which the suggestions may come, should be carefully considered and, if desirable, the changes made accordingly. A more expensive material may be suggested and the suggestion approved due to the fact that, while material cost is higher, manufacturing costs are lower as the more expensive material can be machined or processed at lower cost.

An illustration of what can be done in the field of redesign is the progress that has been made in recent years in substituting pressed steel for cast iron in the manufacture of many products. For example, in the manufacture of stoves cast iron for generations was the only material which was at all practicable for the purpose. Parts were heavy, costs of material handling and freight charges were high, breakage of parts was not uncommon, perfectly fitting castings were more or less difficult to make. A redesigning of the

parts and the use of pressed steel in place of iron castings has brought uniformity of parts, a decrease in weight of anywhere from 25% to 75%, absence of breakage, increased strength, no machining necessary, and what is a factor in the modern stove, a smooth surface that permits of an even enamel finish at 30% to 50% less cost than enameling on a cast iron surface.

Another illustration is the transmitter face used in the telephone. Formerly the brass (nickel-plated) face of the telephone transmitter was made as a casting, another case of many men producing a small output—with much of it failing to meet the high standard required. Today the transmitter face is punched out of a brass strip at far less cost. One man produces more than the crew of yesterday and with a far higher percentage of perfect pieces.

(4) Complaints as to design, whether from salesmen, operating men or customers, should be carefully considered and, if advisable, changes in the design made. No changes should be made unless authorized by the engineering department. As the engineering department is responsible for the design of the product, it follows that it must be responsible for all changes in design regardless of how small or how great.

(d) As to the elimination of unnecessary parts and interchangeability of as many remaining parts as is practicable. The fewer the number of parts and the simpler the construction of those parts, the cheaper it is to make the parts, to assemble them and to repair the product when necessary after it has been placed in use. The ease and cost of repair work are frequently a deciding factor in purchasing machinery, equipment and other products. If several types of product are made they should be alike, in so far as is practicable, not only in individual parts but also in unit assemblies, thus serving to eliminate excess variety and high costs. Failure to standardize parts and to make them interchangeable results in waste due to unnecessary designs, detail drawings, patterns, castings, dies, forgings and variety of tools, as well as increased inventories on parts and general lowering of plant efficiency.

The principle of standardization and of interchangeability of parts and sub-assemblies may be carried to a considerable extent, especially in the manufacture of one general class of product which is fairly well standardized but which varies in size. An illustration

of this point is in the case of the Jones and Lamson Machine Company.

One class of product manufactured is the flat turret lathe[1]—"2¼-in. machines" and "3-in. machines," and "double spindles"—these being the shop terms for the three styles in which the turret lathe was built. These machines were designed on the same general plan, and many of the parts in the 2¼-in. and 3-in. machines interchanged, but this was not true to any extent of the double-spindle turret lathe.

A redesign of these three types was therefore undertaken to make them as nearly alike as possible, not only in their separate individual parts but also in their unit assemblies. This redesign was so successful that they are now able to assemble three basic sizes (or, with varying equipment, seven types in all) from the same parts with the following variety of major castings:

2 Headstocks	2 Turret Slides
2 Spindles	3 Turrets
2 Beds	

and a few minor parts.

Figures 33 and 34 show respectively the 3-in. and double-spindle headstocks. In the elevations, Figures 35 and 36, the same shafts are marked by corresponding letters. These shafts, with their complete assemblies of gears, clutches, ball bearings, etc., as well as the spindles and their gears and boxes, can be interchanged in either headstock. Except for one or two minor points, the man who assembles one of these shafts need not know into what style of machine it is going.

For a 2¼-in. headstock, with its higher spindle speed, the driving-gear ratio at *A* in Figure 35 is altered, and a spindle with a different nose used. About the only criticism which could be directed against this redesign relates to using the powerful 3-in. drive on this 2¼-in. machine. It is much more powerful than is needed. But it is cheaper to make it alike and heavier, than lighter and different.

Besides bringing the design of the machines together, the variety of parts in a given machine was greatly reduced. For instance, the design of the friction clutches on the different shafts was made the same. These are of the multiple-disc type. On the fast-running shafts with light torque, thicker and fewer hardened discs are used. On the slow-moving shafts with heavy torque, more and thinner ones are employed. All of this work practically cuts in half the total number of kinds of parts to be dealt with in making the full line.

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[1] See Figure 87 in Chapter XXV.

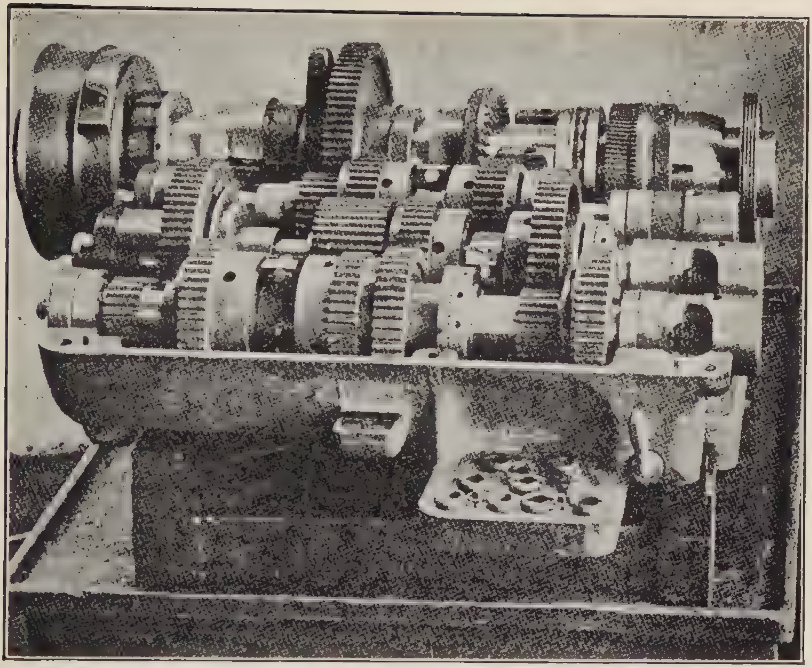

Figure 33. Headstock of 3-In. Flat Turret Lathe

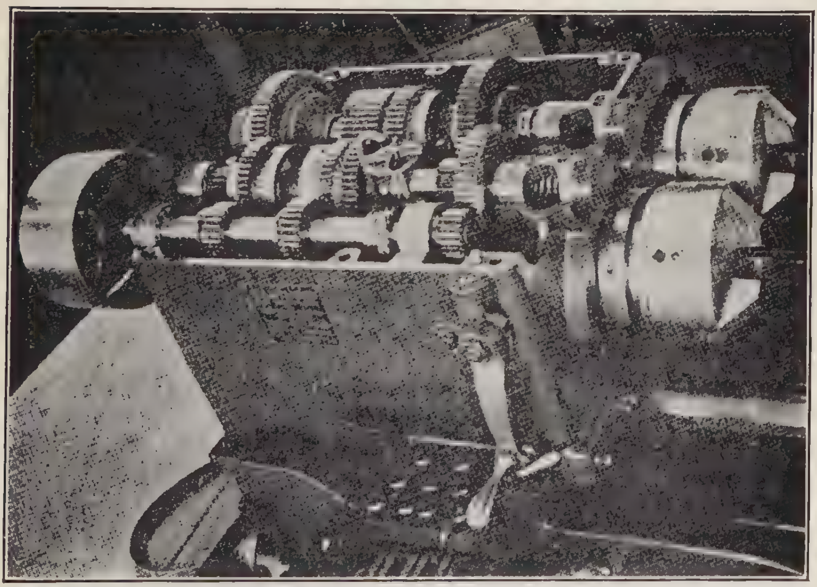

Figure 34. Headstock of Double-Spindle Flat Turret Lathe

The three basic sizes of machine having thus been unified in design, they became for all practical purposes one machine. The workmen scarcely know which size they are working on. They may be put through the assembly in groups of fifteen or twenty each, or mixed together indiscriminately, without making a break in the routine of manufacture.

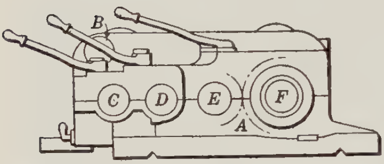

Figure 35. Elevation of Headstock Shown in Figure 33

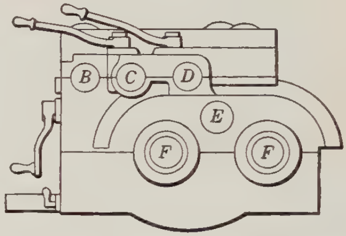

Figure 36. Elevation of Headstock Shown in Figure 34

It is needless to say that the range of the machines built was carefully determined to cover the largest practicable percentage of the lathe work of the world, in order to give the broadest possible market for the intentionally restricted line.[2]

2. *Study raw materials so as to insure procuring the best materials for the purpose and specify which materials should be used and where.* Test not only the materials in use but new materials when necessary. Frequently the use of new materials will not only cut the cost of materials or of machining but improve the product as well.

3. *Determine the machines on which the manufacturing operations are to be performed and the tools, jigs, fixtures and gages necessary for use in the manufacture of the product.*[3] (For definition of these terms see Chapter XXIII.)

4. *Design or be responsible for the design of special machinery required and advise with the production and purchasing departments in regard to buying new machinery and equipment.*[3] The man who designs must be well acquainted with the process of manufacture and have wide experience in the use of machinery and tools. To use

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[2] Extract from paper presented at the annual meeting of American Society of Mechanical Engineers, December, 1924. "Design, Manufacture & Production Control of a Standard Machine," by Ralph E. Flanders.

[3] Frequently cared for by the tool and equipment section in the manufacturing department.

a special machine in cases where the volume of work does not warrant it or where the work in question could be done as economically on a general purpose machine results in unnecessarily tying up capital in plant equipment and adds heavily to overhead charges and final cost of the product.

5. *Estimate costs.*

6. *In cooperation with the purchasing and manufacturing departments decide whether it would be to advantage to buy or make various parts.* With a variety of parts, required in comparatively small quantities, it is frequently cheaper to buy the parts than to make them.

7. *Investigate and report on all patents or suggestions in regard to the product.*

8. *Render engineering counsel to the sales department.* The engineering department should cooperate with the sales department by rendering promptly upon request specifications and estimates of cost for equipment to cover stated requirements. They can be of material assistance to the sales department by emphasizing standards of design and by securing the adoption by the purchaser of a standard line of equipment. In addition, the engineering department should give to the sales department information in regard to particular effectiveness of design, quality of material used and so on, which will aid the salesmen in demonstrating to the prospective customer the merits of the product.

Furnishing Data.—Under the second function, that of supplying the necessary data to the manufacturing department, the following duties must be performed:

1. *Assign part numbers.* In order that parts may be readily and accurately recognized, each part is given a number or symbol. Records are kept of part numbers or symbols used, the record showing the drawing or part number or symbol, a brief description of the part, if the part is a casting the pattern number, and if a forging the die number. When the same part is used in several assemblies it retains the same part number in each assembly.

2. *Supply parts list.* A parts list is a list of all parts required in the finished product. It shows the part number or symbol, the

part name, the quantity required per assembly, whether manufactured or purchased, the kind of material, the dimension of rough stock. The parts list serves many purposes, chief of which is, it facilitates production planning and aids the cost division in figuring the cost of assemblies; it permits the manufacturing department to determine the number of each part required on order; it facilitates the delivery of required materials from the stockroom and the purchase of materials not in stock sufficiently in advance so as not to hold up the production schedule, it aids the tool design section in determining what new tools, jigs and fixtures must be designed and made, and in scheduling their manufacture. In other words, the parts list lays a basis for the planning of work through the shop.

3. *Provide detailed drawing of each part.* The design of the product is analyzed and detail drawings of each part and assembly are prepared. These drawings show in detail what is to be made and define all requirements. The blueprint of each part shows the limits of all dimensions of that part. That is, each dimension is clearly shown and with it the limitation of variance that will be allowed. For example, the diameter of a shaft at a certain point may be 1.0625 ± 0.005 in. The proper gage equipment must be provided to check the required accuracy.

Where the quantity produced of a given article is small, the blueprints are used as the working standards and the gages provided are the regular adjustable precision instruments. Where the quantity produced is large, fixed dimension gages are supplied, where practicable, to serve as the shop working standards and to facilitate speed of production. Usually, in such cases the blueprints are not given to the worker but a copy for information purposes is given to the foreman in charge.

In order to clarify the use of terms defining allowed variations, the following three definitions are given: [4]

Allowance—variation in dimensions to allow for different qualities of fit.

Tolerance—allowable variation in size equal to the difference between the minimum and the maximum limits.

Limits—two sizes expressed by positive dimensions, the larger being termed the maximum, and the smaller, the minimum limit.

[4] Taken from the "Progress Report of the Committee on Limits and Tolerance in Screw Thread Fits, to the Council of the American Society of Mechanical Engineers," *Mechanical Engineering,* August, 1918.

An example will show clearly how the above terms are used in practice. Suppose the dimension of a certain shaft is 2.121 in. in diameter and for the purpose for which it is to be used good engineering practice would permit an allowance of plus 0.000 and minus 0.003 and the hole of the bearing in which the shaft fits to be 2.125 in. diameter plus 0.003 and minus 0.000. The tightest fit would be between the 2.125 in. hole and the 2.121 in. shaft (0.004 in. difference). The loosest fit would be the 2.128 in. hole and the 2.118 in. shaft (0.010 in. difference). The former is the fit to be aimed at and the latter is the poorest that would be "tolerated."

If limits are not specified on the blueprint it will prevent interchangeability of parts and will result in waste due to parts not fitting in assemblies, to excessive labor cost (operators trying to obtain exact dimensions—an almost impossible feat), and to inspectors having to decide continually whether or not a finished part is close enough to the exact dimensions to allow it to pass inspection.

Figure 37 is a detailed drawing of an axle drive pinion shaft. Note that everything is shown in detail on the drawing. Each change in the original drawing as it becomes necessary is recorded at the top of the drawing. The bill of material, etc., is at the bottom right. Notes of instruction are at the bottom left. Particularly note that there is an allowable variation specified for every dimension given. This allowable variation is given either directly on the drawing or cared for in a note at the bottom left corner of the drawing.

4. *Prepare operation sheets.*[5] An operation sheet is prepared for each part of the product which is made in the plant. It is in reality an analysis of the manufacturing processes necessary to produce the part. The items listed on an operation sheet will depend upon the kind of work and the extent to which planning is carried in the particular plant. Among the items which may be listed are the actual operations required and their sequence, the section or shop in which they are to be done, the type of machine used, the jigs, fixtures, gages and other tools needed for each operation, tooling instructions (when necessary), the time allowed for each operation, that is the estimated hourly output and the inspection required. Other items listed may be the exact size and quantity of raw materials required per piece, the number of pieces per job, the stockroom where the raw

[5] Frequently cared for by the tool and equipment section in the manufacturing department.

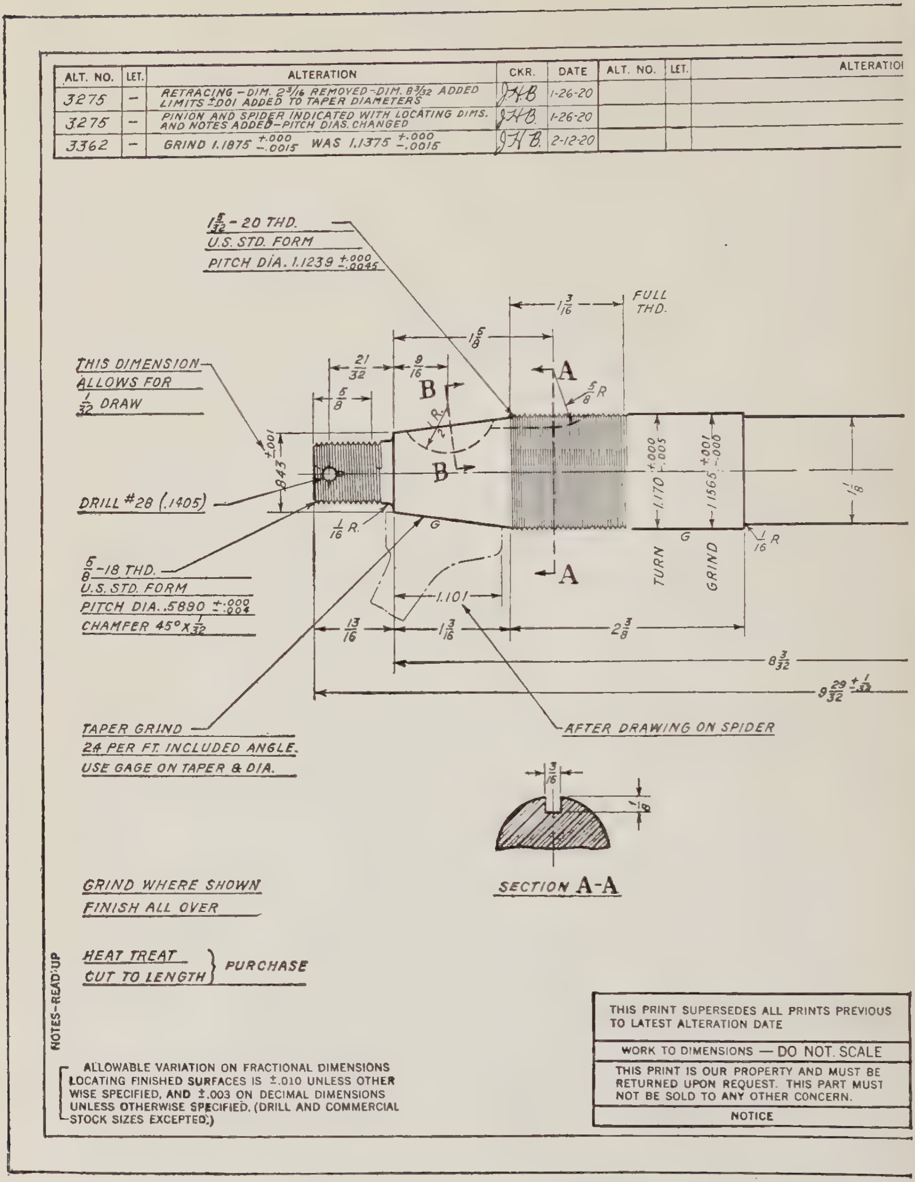
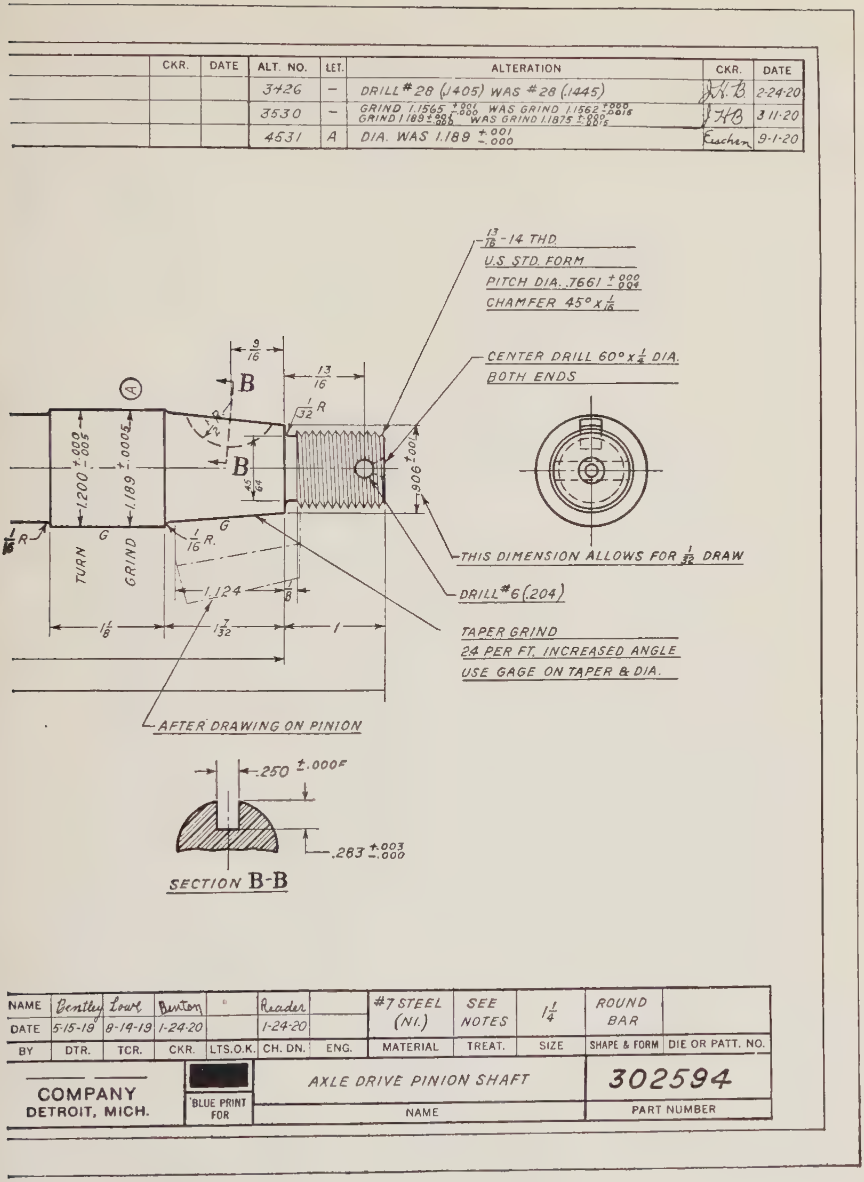


Figure 37. A Detailed Drawing



of an Axle Drive Pinion Shaft

materials are stored, and the storeroom to which the finished part or assembly is to be delivered after final inspection. The operation sheets are used for purposes similar to those mentioned under the uses of a parts list.

In assigning part numbers, supplying parts lists, providing detailed drawings of each part and preparing operation sheets, the engineering department prepares the way for the actual making of the product and raises the standard of manufacturing, as all information supplied is based upon careful, analytical study of all factors concerned.

Changes in Design of Products.—Inasmuch as the engineering department is responsible for the design of the product, it is also held responsible for any changes which are made in the design. No change should ever be made by any department until first authorized by the engineering department. When a change in the design of a part is found to be necessary, the enginering department issues a "notice of engineering change" which is sent to all departments and persons in charge of work which will be affected by the change. They can then be on guard and take whatever steps may be necessary in connection with their part of the work in preparing for the anticipated change. Later the engineering department, after careful consideration of all factors, issues an "engineering release notice" which puts the change into effect at a certain definite time. The engineering department keeps record of the serial number of the finished product on which the change was first made. This is necessary for replacement purposes should a customer order repair parts.

The problem of change in design is an important one and in many cases is far-reaching in results, both in cost and otherwise. A change in design may be due to a variety of causes. It may be for the purpose of reducing the cost of the product by using a less expensive material in one or more of its component parts or possibly a more expensive material but one which can be processed at a much lower cost. Again, the cause of the change may be a desire to simplify the design so as to simplify the manufacture of the product and lower manufacturing costs. It may be necessary in order to correct a weak or unsatisfactory part or it may be desirable on account of some improvement which the engineers have worked out. Sales competition, change in style, new trade requirements and so on also may make a change in design necessary.

Cost of Changes in Design.—In the manufacture of many products minor changes are being made continually for the purpose of improving quality or reducing costs. Most of these changes are principally for the improvement of the manufacturing processes and usually originate in the engineering department or through recommendations made to the engineering department by the foremen, time study men, tool and equipment men, inspectors, or others who, due to their everyday contact, see the need for these changes. Major changes, however, which cannot be made at a nominal cost and which would cause more or less interruption of production should be carefully considered by a committee appointed for that purpose and the changes authorized by the management before they are adopted.

In making any change in design the various items of cost involved in putting the new design into production should be carefully considered and an estimate made. The urgency of the change is an important item. To put any change into effect requires time. If the need for the change is urgent and it must be put into effect at the earliest possible moment, it must be expected that costs will mount. For every change there is a minimum of elapsed time below which a change cannot be put into effect without proportionately increasing costs above a normal estimate.

The more important items entering into the cost of putting a new design into production are the cost of designing, making a model, thoroughly testing it, designing and making the new dies, patterns, jigs, fixtures, tools, gages, etc., as well as the loss due to the scrapping or reclaiming of the dies, patterns, jigs, tools, etc., used before the change is made; the obsolete materials and parts caused by the change taking into consideration those required for repair service on the models in which the old design was used; idle machinery and loss of production during the time of change over; high direct labor costs during the time of change over until production is running smoothly again; cost of developing new time and other standards and so on.

In this brief discussion it is desired to bring out two important points. First, the importance of knowing the cost of making changes in design and putting them into effect; and, second, the need for careful planning before the change is put into effect so that when the change is made things will go smoothly and with a minimum of expense and effort.

Organization of the Engineering Department

Director.—Figure 38 gives a suggested form of organization for an engineering department.

At the head of the engineering department should be a broad-minded, capable engineer as director. He should be thoroughly familiar with the engineering requirements of the particular kind of products to be made and, in addition, he should have a broad knowledge of machinery and tools and their use, of manufacturing methods and processes gained through technical training and practical experience.

The director of engineering is responsible for the efficient conduct of his department and for the cooperation which should exist between his department and the sales, purchasing and manufacturing departments.

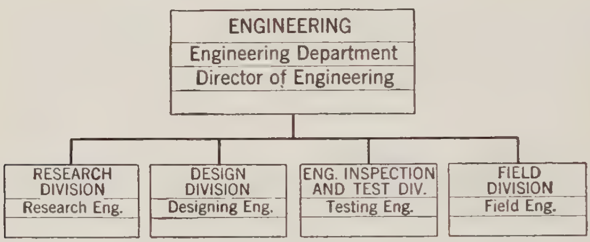


Figure 38. Organization of Engineering Department

Research Division.—The research division, as the name implies, has charge of all research, experiments and tests. It is the function of this division to test new materials, to work up new products, to improve on old ones, to investigate patents and suggestions in regard to the product or allied products. For example, in the research laboratories of one prominent motor car manufacturer there is a large cold test room. The temperature can be lowered to more than 25 degrees below zero. Here such tests as ease of starting, acceleration, gas consumption, the dilution of oil and other factors of winter driving are carried on so that weaknesses can be detected and design improved.

Design Division.—The design division takes the data of the research division and puts it into shape for factory use and for rec-

ord. It is the function of this division to determine the characteristic lines and to design the product, to provide detail drawings, and assign part numbers, provide specifications, parts lists, operation sheets and other similar data for the manufacturing and other departments.

Engineering Inspection and Test Division.—The function of the engineering inspection and test division varies with the individual concern. It may have charge of metallurgical, chemical and other tests on materials or products and of the inspection and test of the finished product. For example, it may be responsible for supplying log and data sheets for, and sometimes actually supervising, the final motor test relative to the developed horsepower, and so forth. Such inspection and testing as carried on by the engineering department must not be confused with the work of the inspection division, as brought out in a subsequent chapter.

Field Division.—The field division has charge of installation at the customer's plant. In many concerns such a division would not be required as the products do not require installation or if they do they can readily be installed by the customer's employees. Where the article purchased is a machine and installation service is provided, instruction in the correct operation of the machine is frequently given at the time of installation. Such service should always be taken advantage of by the customer as faulty installation or incorrect operation of the machine by the employee and maintenance in many cases materially detracts from the efficiency of the machine and the resultant quality and quantity of the work produced.

CHAPTER XV

PURCHASING DEPARTMENT

Purchasing Function—Its Scope and Importance.—Purchasing is a primary function as it covers the procurement of all materials, equipment and supplies necessary for the conduct of the business. In many cases the cost of the finished product and the margin of profit depend upon the efficiency with which raw materials and supplies are purchased. To meet present competition advantage should be taken of every opportunity to save on costs whether they are labor costs, overhead or material costs. This does not mean that purchasing should concern itself merely with the question of price. A saving effected on the buying of materials would prove a costly one if the materials purchased, due to the low price, were not of the quality needed and would require additional labor in fabricating or would lower the standard of product made from them or if the vendor were an unreliable firm and the materials were not delivered promptly when required and thus cause production delays. Scientific purchasing, therefore, takes into consideration, in addition to "price," the factors "quality," "quantity" and "service."

"Quality" is covered by specifications which are drawn up for each class of material, supplies, or equipment required; "price" must be the lowest obtainable, secured through competitive bidding upon the specifications set; "service" includes the delivery of the proper quantity of the required materials when needed so that stocks may be maintained at a minimum of investment and yet be at all times sufficient for production needs. Scientific purchasing involves a knowledge of the materials needed to meet the production schedule, of present conditions and tendencies in the commodity markets and of the company's financial condition so as to keep all three in harmony. Market conditions may favor buying in large quantities but if credit cannot be secured at advantageous terms the financial condition of the company may preclude the purchase of all but the barest of necessities. Again, the arrangement of payments whether in one sum or in a series of instalments may be a deciding factor.

Intelligent purchasing brings with it a reduction in the amount of capital tied up in inventories and a minimum of obsolete material, yet at the same time efficient operation of the plant due to having sufficient quantity of materials best suited for the purpose on hand when wanted. This later tends to produce a better product and to cut down losses due to idle labor, equipment and machinery.

Place of the Purchasing Department in the Organization.—The place of the purchasing department in an organization depends chiefly upon the importance and nature of the purchasing in that particular concern.

1. *Purchasing as a division of the manufacturing department.* It is claimed that this arrangement permits of more effective correlation of the purchasing function with that of engineering, inspection and production. Other concerns advocate that this necessary correlation of functions and cooperation can be obtained through conferences at stated intervals or by the use of committees and by a proper system of material control.

2. *Purchasing subsidiary to sales.* This arrangement occurs only where the materials are promptly resold after but a slight and comparatively inexpensive manufacturing process.

3. *Purchasing and storeskeeping combined.* This plan is frequently employed in small and medium-sized concerns where the volume of work is not sufficient to warrant their being organized independently. While the functions are clearly related their combination is not essential or desirable in a large concern as a proper system of records and reports will give the purchasing department all the information it requires in regard to stores, and at the same time the records and reports of stores will act as a check on the work of the purchasing department.

4. *The purchasing function considered as a major function and a separate department set up for it similar to that of manufacturing and sales.* The discussion following will be from such a standpoint.

Organizing for the Purchasing Function.—It is essential that all purchasing should be through the purchasing department only. Without such an arrangement each department head buys according to his own idea of the needs of his department with little or no consideration for the needs of the concern as a whole. This is a loose, inefficient method. The department heads are interested primarily in

the special work of their departments. With them, purchasing is a secondary and frequently an unimportant duty to get over with as quickly and with as little effort as possible. They have neither the time nor the inclination to study the market, the dependability of the firms selling the goods needed and the price quoted. If market conditions are normal they ordinarily can secure delivery at a proper price and fair selling terms, but if the market is tight or conditions unusual they are very likely to pay an excessive price and to have trouble in getting prompt deliveries. They are at the mercy of the salesman who knows the market and is taking every possible advantage of all conditions favorable to him. The salesman is at home, he is a specialist practicing his art; the department head, in the rôle of a buyer, is in a foreign field, one which he does not know and ordinarily does not appreciate at its true value.

When purchasing is done by a department head or superintendent, it is frequently done hastily by telephone to a favored salesman or firm or by a verbal order to a salesman who happens to call at an opportune time. Purchasing under such conditions goes from one extreme to the other, either a stock of materials and supplies is carried on hand far in excess of production requirements or production is held up by stocks becoming exhausted before a new supply can be secured. In addition, quality of materials may be sacrificed as buying interferes with regular duties and department heads cannot take the time to investigate the merits of products of competing manufacturers or to check on the quality of goods ordered and those received.

Purchasing by a Specialist.—Purchasing can only be done successfully by a purchasing specialist. The larger the company and the volume purchased the greater the benefits in price, quality and service which will be derived through centralization of the purchasing function, unless, of course, the concern has a number of plants in different sections of the country, each requiring different materials and supplies which can best be obtained in local markets. In this latter case the purchasing function may be taken care of by setting up a purchasing division in each plant. The head of each division may then be given the title of purchasing agent with the head of the central purchasing office being known as the general purchasing agent. Thus, one of our well-known industrial organizations has a purchasing agent in each of five cities: Atlanta, Boston, Chicago,

Dallas and San Francisco, with a general purchasing agent in the home office in New York. All purchasing efforts in such an instance are coordinated through the general purchasing agent and the work standardized under his direction.

In many instances certain of the needs of the several plants of a company will be common to all plants, while other needs will be peculiar to a certain plant only. In such cases needs common to two or more plants are taken care of through the centralized purchasing department, leaving the local purchasing divisions to secure the materials and supplies which can best be bought in their local markets. Usually they also will be permitted to order emergency supplies so as to save time and possibly avoid a shut-down. In all cases, however, the local purchasing agents are responsible to the general purchasing agent for the conduct of their divisions in accordance with the policies and plans as outlined by him, and copies of all orders for materials and supplies must be sent to the central office for its information and check.

The National Association of Purchasing Agents in a recent bulletin summed up the advantages of centralization of the purchasing function as follows:

"1. Having a skilled purchaser upon whom devolves responsibility for buying: (a) He devotes full time to the business of buying. (b) He keeps informed on market trends and up-to-date purchasing methods.
2. Saving in time, effort and cost of operation of a central purchasing agency or by supervision over separate departmental agencies.
3. Lower prices and better deliveries on large orders representing aggregate needs of the entire organization.
4. Standardization of supplies, materials and equipment.
5. Central supervision over: (a) disposal of surplus stock by transfer between departments or plants, or by sales. (b) Storage and distribution of production commodities. (c) Checking deliveries.
6. Better fiscal supervision over expenditures by close cooperation between finance and purchasing departments: (a) Cash discounts saved by prompt approval and payment of invoices. (b) Duplicate payments eliminated by double

check on invoices. (c) Profits increased through orders in advance of need on favorable markets when finances will permit.

7. Time and amount of purchases regulated by advance sales forecasts, by information of stock on hand in raw materials and finished products, and by knowledge of market trends."

Functions of the Purchasing Department.—Among the principal functions of the purchasing department are the following:

1. *Make purchases of materials, equipment and supplies as authorized by properly approved requisitions.* One desiring materials or supplies fills out a requisition form stating what he wants, the purpose for which it will be used, and when he wants it. The form duly filled in is examined and checked by the department head, or other authorized person who sees whether the materials and supplies so covered are really needed and whether the requisition has been properly stated, and if so, signs it and sends it to the stores department. If the materials needed are not in stock the storeskeeper or some other authorized person makes out a purchase order requisition, being certain that all required information is given, that the materials or supplies are clearly defined and that in cases where standard specifications covering such materials have been previously set, the materials ordered coincide with those specifications. Some concerns allow any of their department heads and other authorized persons to write purchase order requisitions.

Such concerns maintain that it consumes too much time and involves too much clerical effort to have all requisitions go through the storesroom. Other concerns maintain that service is better and purchasing more economical and efficient by what is apparently the more indirect and slower procedure. They point out that the person desiring the materials or supplies would have to look through an index of stocked materials in order to know whether the goods were already on hand, that the person ordering would not be familiar with the standard specifications set for like and similar materials and that they would not know other departments' requirements of the same article nor the proper quantity to order, with the result that purchasing would be inefficient and stocks of obsolete materials would pile up.

2. *Obtain the lowest prices and the best buying terms possible,*

other things being equal. Every buyer is interested in obtaining as much for his money as possible, yet an order should not be placed solely on the basis of price. The goods purchased may not be at the lowest market price, but at the same time they may be at the lowest price consistent with the quality required in the requisition. Quality and service should be considered as well as price. Only when the suppliers bid on the same quantities and specifications, are firms of equal standing and responsibility, and are prepared to give equal service, should price be the determining factor. A bid that is materially lower than the others submitted often conceals a joker which must be guarded against. Goods and service must be paid for and their quality is usually in proportion to their cost. Thus, a cheap article is often expensive in the end. The good buyer seeks to reduce his costs but he buys with foresight and considers other factors besides price alone.

3. *Secure delivery of materials when promised.* In order to do this there must be maintained a systematic follow-up of purchase orders and a record of all unfilled orders under contracts.

4. *Attend to all purchasing details.* This includes securing quotations for material, writing of purchase orders, checking of invoices and the other details incident to the placing of an order and the receipt of goods purchased.

5. *Keep necessary records.*

6. *Maintain a traffic division if the traffic function is not taken care of as one of the functions under the manufacturing department.*

Qualifications of Purchasing Agents.—The purchasing agent, to fill his position as head of the purchasing department properly, must first of all be honest, for he is in a position to meet opportunities of personal gain in return for favoritism in awarding contracts. These he must reject with the contempt they merit. Yet he must be broadminded and tactful and not take offense at a simple courtesy where no obligation is intended. He must be open-minded, sincere and of good personality. The "show-me" purchasing agent, who carries a grouch and makes a salesman feel he is conferring a great favor upon him in seeing him at all, rarely secures full cooperation from salesmen. A great deal of valuable inside information relative to products and market conditions can be secured from salesmen. The alert purchasing agent realizes this and makes a friend of a sales-

man and not an antagonist. This does not mean that he talks over all questions of the day and uselessly consumes his own time and that of the salesman, but rather it means that he listens courteously to what the salesman has to say and does not keep him standing, feeling like a chastised schoolboy. He meets the salesman halfway and keeps his goodwill even when he does not place an order. In other words, the purchasing agent should be frank and human, a versatile, broad-gage man with a good sense of values and a thorough knowledge of all phases of purchasing work. This necessary knowledge includes the following:

1. Knowledge of Economics.—The purchasing agent should understand the economic structure of business in all its phases and should be able to make practical, everyday use of this knowledge. The rise and fall of prices, the laws which govern these movements, the credit structure—these and many other matters of practical economics have a direct bearing upon the purchasing function.

2. Knowledge of Sources of Supply.—The purchasing agent should learn how to locate and evaluate new sources of supply. He may need a knowledge of natural resources in different parts of the world, of the relative advantages of domestic and foreign buying and of conditions that might tend to affect these. He will need considerable general and specific information regarding those particular markets in which he is most actively interested. He will want to know the business methods and practices of the various competing supply houses in those fields, the reliability and extent of resources of the various houses and the service rendered by them. He will want to know the names of those firms that habitually promise more than they can perform. Likewise he will want to know the names of those firms that can always be depended upon to live up to their promises, and that are always willing to cooperate fully with the buyer in his efforts to secure materials, even to the point of inconveniencing themselves to meet emergency needs. He should know just what the market offers, what he can get and where he can get it. He should know where he can go in case of emergencies when, for one cause or another, his regular source of supply is closed to him. All of this requires a fund of information which cannot be hastily acquired but, in many cases, takes years of experience and research.

3. Knowledge of General Business Conditions.—To be efficient, the purchasing agent should be a keen student of general business conditions, constantly on the alert for news that may affect prices and market supply. He should be able to detect any tendency toward an advance or decline in the general market and particularly in those commodities in which he is most actively interested. He can then anticipate his needs with contracts for a long period in advance in case of a rising market or can follow a hand-to-mouth program of buying where the tendency of the market is to decline.

4. Knowledge of Production Requirements.—To buy goods intelligently the buyer should know the use to which they are to be put. This necessitates a working knowledge of manufacturing processes. Although the purchasing agent usually purchases under specifications drawn up for him for each article or class of material purchased, the specifications frequently are so set as to permit of selection within certain limits. In many cases from his knowledge of manufacturing processes and needs, the purchasing agent can suggest some slight modification in the specifications which will enable him to buy standard products, where otherwise special products would have to be purchased at a considerably higher figure and frequently with costly delay in delivery. If the purchasing agent has a knowledge of the use to which an article is to be put he can frequently, from his study of the market, suggest a substitute which will better suit the needs or which is a new material or product just on the market and can be bought at a much lower cost. The modern buyer is a buying specialist with a fund of technical knowledge. Frequently he knows as much of the physical properties or chemical analysis of a material or an article he is buying as does the salesman who is endeavoring to make the sale. If he combines with this technical knowledge a knowledge of the use to which the material is to be put, he becomes a very valuable and practically indispensable part of the organization and a big factor in the increase of profits through efficient purchasing of required materials and supplies.

5. Knowledge of Office Procedure.—A knowledge of office procedure is essential as considerable clerical work is required in carrying on the purchasing function. When this clerical work is properly systematized the department can render better service.

6. Knowledge of Commercial Law.—In his relations with vendors the purchasing agent is continually dealing with questions that are governed by law. The legality of contracts and agencies, the matter of warranty, the passing of title, the liability of purchaser and vendor under various circumstances, these and many other matters of similar or related nature are ones with which the purchasing agent should be familiar. It is imperative, therefore, that he have a thorough understanding of the laws involved so that his acts may be in accordance with them and that he may fully appreciate the legal consequences of his acts. Much trouble and litigation would be averted if buyers were more familiar with the laws applicable to the making of contracts and other purchasing activities involving relationships between buyer and vendor.

Duties of Purchasing Agent.—The purchasing agent as head of his department should so organize and manage his department that all functions assigned to it will be adequately taken care of. He should cooperate with the heads of all other departments in connection with the purchase of all materials, supplies and equipment over which they have charge of specifying the requirements, to the end that the purchases made will best fit the particular needs. One of his major duties is to prepare a purchase budget showing the probable purchases as required to meet the production schedule (as shown by the production budget). In preparing the purchasing budget the purchasing agent should work in close cooperation with the one in charge of the finances of the company, as well as with the head of the production department. The financial manager should know not only the total estimated financial commitments but their distribution over the budget period. In many cases the purchasing agent can relieve any undue strain upon the finances of the company by making a more equable distribution of purchases. When the materials will have to be paid for is an important factor. A quantity discount, no matter how attractive, may prove of decided disadvantage if making the purchase of such a quantity strains the finances of the company. In addition, the purchasing agent must prepare a purchasing department expense budget showing the probable cost of running his department for the budget period. For a discussion of the purchase budget and its relation to the other budgets of a company, see Chapter XXXII.

Organization of the Purchasing Department

Staff Required.—In organizing the purchasing department the purchasing agent breaks down the purchasing function into its subfunctions and sets up the necessary divisions to care for them. The organization of the department depends upon the amount and nature of the yearly purchases. A concern buying under contract large quantities of a few materials and supplies will require a different kind and a smaller purchasing staff than one buying a variety of materials and supplies in smaller quantities. The latter would require a considerable clerical force to handle the many details inci-

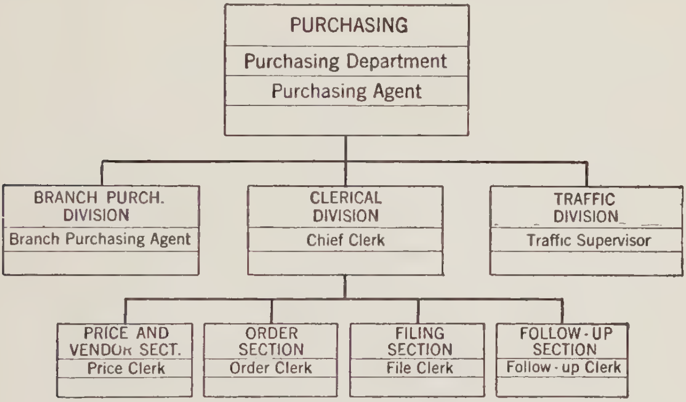


Figure 39. Organization Chart of Purchasing Department

dent to buying and follow-up of orders; the former, while requiring only a small staff, would have to have a purchasing agent of highest calibre, as an error in letting a contract might change an otherwise profitable year into a decided loss. In the case of letting large contracts there would probably be a purchasing committee which would have to authorize the contract but their decision would be influenced to a considerable extent by the advice of the purchasing agent.

Figure 39 shows a suggestive plan of organization which can be adapted to fit various needs. For example, there may be required an assistant purchasing agent whose function it is to relieve the purchasing agent of much routine work. He may supervise office routine, have direct supervision over the clerks in charge of the various divisions, interview many of the salesmen and in general handle such

routine purchasing as may not require the attention of the purchasing agent. In some concerns of considerable size the volume of material purchased may require that there be a number of assistant purchasing agents, each specializing in a given class of materials. In a small concern only a purchasing agent may be required or at most a purchasing agent with a clerk or two to relieve him of detail. In all cases, however, each function shown on the chart must be cared for. The following gives a brief discussion of each division charted.

Branch Purchasing Division.—Branch purchasing agents are directly responsible to the general purchasing agent for the conduct of their divisions and the purchase of such materials and supplies as they are permitted to do.

Clerical Division.—The duty of the chief clerk is to relieve the purchasing agent of much routine work relating to sources of supply, prices, etc. He examines all requisitions to see whether the materials are clearly defined, the quantity and specifications accurately given and the date required clearly stated. If the article or material required does not conform to the standard that has been set for such articles or materials, or if the date required is before delivery could be secured through regular channels, he immediately gets in touch with the one who issued the requisition and takes up all questionable details with him. Where standard material will suit the purpose equally well, changes in the requisition are made with the approval of the requisitioner.

Where the material or article is required as originally stated, the purchase order is accordingly put through after the details in question have been confirmed by the requisitioner. Where the materials are required by the date requested and delivery cannot be secured in time through regular channels, endeavor is made to secure delivery by express or special delivery or if that cannot be done then from some nearby source, even though it may result in paying a higher price. Where the material is something that has not been ordered before, if time is short the usual method of asking for competitive bids is dispensed with and the order placed immediately with the firm that can assure delivery as asked for. Time is an important factor in production and the purchasing department should lend every effort to secure delivery of materials by the time needed. Failure of goods to be delivered may upset the entire production sched-

ule and seriously hamper or stop production. It is the duty of the chief clerk to see that such conditions do not occur.

All correspondence both outside and interdepartmental which comes to his division for attention is received by the chief clerk and referred with any necessary notations of instruction to the proper section or person in his division. Ordinarily, the following four sections will be sufficient to take care of purchasing needs.

1. Price and Vendor Section.—It is the duty of the price clerk to maintain accurate, up-to-date price records, to examine bids to see that they are in line with the market, to check prices charged on invoices with quotation prices under which orders were placed and similar price details. Painstaking accuracy should be the keynote of the work of the price and vendor section for in the regular everyday work there are many opportunities for inaccuracies which, if allowed to occur, might result in severe losses to the company. A slight advance in the prices charged per unit on invoice from that quoted and agreed to on the purchase order would result in quite a sizable difference in the amount to be paid where the units purchased run up into the thousands, not an unusual case in purchasing for the large corporations. It is the function of the price and vendor section to safeguard against all such discrepancies.

2. Order Section.—The order clerk has charge of the writing of actual orders. He sees that the orders are so worded that they cannot be misunderstood. The quantities and units should be clearly stated and a description given of the specified items. When the articles ordered are standard, the vendor's catalogue number, size, etc., should be given. The purchase order filled out and signed is a legal contract and as such should be drawn with care to protect the purchaser from possible loss or annoyance in case of any dispute in the future over the goods ordered. The majority of concerns use a standard printed purchase order form with all essential conditions covered. It then becomes merely a matter of correctly filling in the printed form in the space indicated. (See Figure 45, illustrating a standard purchase order form and the accompanying description under the heading, "Purchase Records and Forms.")

3. Filing Section.—The filing section is under the line control of the chief clerk and under the functional control of the office

manager. Records showing current and past transactions; the history of orders from the purchase requisition to the actual purchase, receipt, inspection and passing of invoice; records of vendors and other purchasing information, all of which are vital to the successful conduct of the department, should be readily available.

4. Follow-Up Section.—The purchasing department is responsible not only for the ordering of material but for having that material delivered and on hand in the plant when needed. In order to watch deliveries, therefore, and to know what progress has been made in filling orders, a follow-up section is organized which, as the name implies, has charge of the follow-up of all orders placed so as to insure delivery by the date promised. To aid in this work a tickler file is ordinarily used. In it is placed a copy of the purchase order or a separate slip bearing the order number. The top of the copy of the purchase order form or slip is marked off from 1 to 31 inclusive or every other number. A tab is placed over the number corresponding to the day of the month on which the seller has advised that shipment will be made. The signal tabs for a given day arrange themselves in a straight line throughout the order file and can be instantly noted and the cards or order forms picked out. If inquiry shows that the invoice or shipment has not been received a letter should be written or a follow-up form used requesting advice from the vendor as to the shipment in question and the tab moved ahead the requisite number of days for receipt of an answer. The tab should then be changed to conform with their answer if shipment has had to be delayed for any reason. The follow-up clerk in his relations with vendors must keep their goodwill but at the same time be persistent in his efforts, as a great deal of time and money may be lost due to deliveries not being made promptly. The threat of cancellation of the order should be used only when forced to, due to urgent need of materials or in cases where the vendor is not giving the order its rightful attention.

Traffic Division.—The work of the traffic division consists of attending to all matters in connection with the transportation of incoming and outgoing shipments. The place of the traffic division in an organization depends upon the size and type of business. In those concerns where the bulk of traffic is inbound, the traffic division is ordinarily placed under the purchasing department. Where the

bulk of traffic is outbound or the distribution is over a wide area, the sales department may have control of traffic. In some of the larger concerns the present tendency is to have traffic as a separate division reporting direct to the head of the manufacturing department. In this way the traffic division can impartially serve both the purchasing and the sales departments. In a few of the larger concerns shipping and receiving are set up separate from traffic. In the average concern, however, shipping and receiving are taken care of under the traffic division. The shipping section packs, weighs, marks, checks, and loads shipments in accordance with instructions given them by the head of the traffic division; the receiving section receives goods, gives a receipt for them, inspects them, when such work is not handled by the inspection division, notifies the purchasing department that the goods are received and sends the goods to the storeroom to be put in stock.

The work of the traffic division is more important than is ordinarily realized. The cost of packing goods for shipment amounts to quite a sizable figure in many concerns. The progress made in the shipping of motor cars has brought about surprising savings not only in minimizing loss and delay due to breakage, and in the cost of constructing the crate but in transportation charges as well. Likewise, the routing of freight over a different line or a slight change in packing to permit of a more favorable freight rate may, from the savings incurred, pay the greater portion of the cost of maintenance of the traffic division.

Among the more important duties of the traffic division are the following:

1. *To prepare bills of lading.* A bill of lading (B/L) is a contract between the shipper and the transportation company. It serves the shipper as a receipt for the goods described in the bill of lading and is evidence of the agreement of the carrier to deliver the goods to the consignee named in the bill and to be liable for damages to goods in transit.

2. *To audit freight bills.* This involves checking the rate charged, the weight and the charge itself.

3. *To adjust and file claims due to non-delivery or damage of shipments or overcharge due to incorrect figuring of freight bill or improper classification of the materials shipped.*

4. *To keep check on railroad cars on company sidings so as to eliminate, as far as possible, demurrage charges.* A demurrage

charge is a fine assessed by the railroad against a company which keeps cars on its sidings more than a specified length of time. The traffic division keeps a record of railroad cars placed on the siding of the company, the date of arrival, their contents and the date when they are loaded or unloaded, as the case may be and the railroad notified that the car is ready for them.

5. *To prepare packing and shipping instructions.* The traffic division determines the kind of packing to be used, whether goods are to be burlapped, boxed, crated, etc. In deciding as to the kind of packing three factors should be considered: first, protection to the goods shipped; second, appearance of package and the ease of handling; and third, the classification and freight rate, endeavor being made to secure a favorable classification and a correspondingly low freight rate.

Shipping instructions cover the transportation agency to be used whether railroad, express, steamship, parcel post, company truck, etc. The instructions designate, in the case of railroads and steamship lines, the particular lines over which goods are to be shipped.

6. *To trace shipments delayed in transit, to find out the cause of delay and to speed up delivery.* When a shipment is not received in the length of time it ordinarily takes to make such a shipment the traffic division asks the railroad or other transportation agency to trace the shipment and expedite delivery.

7. *To prepare rate charts.* Such charts show the transportation charge from the factory or point of shipment to various central points in the sales territory and aid the salesmen in quoting shipping charges to customers. Similar charts and information pertaining to materials and supplies required are given to the purchasing department.

8. *To furnish information concerning export shipments.* The kind and cost of packing required for export shipments, the cubic space required, the weight of shipments including the weight of the container, the freight rate both domestic, on steamship and abroad until the shipment reaches its destination, marine insurance premiums, internal taxes in foreign countires, etc., are all a part of the information the traffic division would be expected to supply regarding foreign shipments.

9. *Provides local transport service for local deliveries and hauls*

to and from the railroad in cases where the company has no railroad siding.

10. *When receiving and shipping are included as a part of traffic, the duties of receiving and shipping should be added to those of the traffic division given above.* (a) *Receiving*—receive goods, receipt for them, inspect them, notify the purchasing department that the goods have been delivered and turn them over to the storeroom to be put in stock. (b) *Shipping*—pack, weigh, mark, check and load in cars or deliver to the transportation agency all goods to be shipped, keeping record of everything that is shipped and sending a copy of such record to the accounting department.

Purchase Records and Forms

System of Record Keeping.—Purchasing involves taking care of an infinite number of details. The problem then becomes one ot devising a system of record keeping which will adequately cover all the data required at a minimum of clerical work. No two purchasing departments are identical, each has its peculiar needs, yet each has basic problems in common. Each must have record of when, why, where, how and from whom each purchase was made. Quality, quantity, price, length of time for delivery, credit terms and service in general must all be made a matter of record and not left to memory. Care must be taken, however, that record keeping be not carried too far. Record keeping in some purchasing departments is vastly overdone and becomes an endless, and in the greater part, a useless task. Common sense should prevail at all times. It is folly to maintain, for example, at considerable effort and expense a separate record of sources of supply when the names of sources are all readily available in a catalogue file and on the purchase record cards, and in the quotation file are shown the names of all vendors from whom quotations have been asked and materials have been purchased in the past.

Records should be above all reliable, as figures that are inaccurate are worse than useless. They are dangerous as, being figures, they give a semblance of accuracy and so are often even more detrimental in planning future purchases than guessing or "playing a hunch" might be. They should be adequate, as incomplete records are often misleading. They should be simple so that they can readily be main-

tained by the average clerk. They should be permanent and suitably cared for to protect them and to keep them always accessible for use. Any number of records, no matter how inclusive, are of little value if they are not kept up-to-date and readily accessible. Records are for everyday use and not mere history of the transactions of the department.

Forms always should be drawn up with care, attention being given to all needs and with the view of making them as concise and explicit as possible so as to avoid all chance of error. The forms illustrated below before being adopted by any industrial concern may have to be modified to meet needs peculiar to that concern. Some of the information may not be necessary; in other cases it might be desirable to have additional information. The accompanying discussions are purposely brief. They will be supplemented with more detail in subsequent chapters when the subject of production control is covered.

Requisition for Materials.—Purchase of materials is only made upon requisition duly signed by an authorized person. Requisitions for certain materials may require approval by some designated person other than the head of the department from which the requisition originates. The purchasing department must, therefore, have on record the names of all those authorized to approve requisitions and the extent of their authority. Where two or more approvals are necessary, as for example the approval of the storeskeeper, the chief engineer and the factory manager, the record should show the need for all three approvals and a requisition coming in for materials requiring such approvals should be immediately returned to the originator of the requisition if all three signatures do not appear. The following covers points common to all requisitions:

1. The form should be of standard size for convenience in filing.

2. Each person authorized to originate requisitions is assigned a number series. Requisitions should be numbered in sequence for convenience of the requisitioner in following up and of the purchasing agent in filing.

3. Definite instructions should be given as to kind, quantity, the unit in which it is measured and the quality of material ordered.

4. The date of making the requisition and the date upon which the material must be delivered and on hand should be stated. The

purchasing agent is responsible for getting the materials as specified by the date required unless he reports within a reasonable time that it is impossible to do so and the reasons why.

DAY & ZIMMERMANN
ENGINEERING & CONSTRUCTION CO.
ENGINEERS

PHILADELPHIA, PA. ____ 19__

FOR THE ACCOUNT OF ____ PURCHASER

____ SELLER

SHIP TO ____

VIA ____ DELIVERY F. O. B. ____

PURCHASING DEPT. COPY

MATERIAL REQUISITION

(NOT TO BE USED FOR CONTRACTS)

PURCHASE ORDER No. ____ CHANGE ORDER No. ____

IN CASE OF CHANGE ORDERS THE TERMS AND CONDITIONS OF THE ORIGINAL ORDER REMAIN IN FULL FORCE AND EFFECT, EXCEPT, AS SPECIFICALLY NOTED HEREIN.

MAKE SEPARATE REQUISITION FOR ARTICLES THAT CANNOT BE PURCHASED FROM ONE DEALER.

TOTAL NET AMOUNT OF ORDER PREVIOUS TO THIS CHANGE $

PLEASE ORDER THE FOLLOWING:- TO BE USED ____

TO BE CHARGED AGAINST SYMBOLS ____

SYMBOL	QUANTITY	DESCRIPTION	NET UNIT PRICE		

DELIVERY WANTED, TOTAL THIS ORDER ____ TOTAL ORDER TO DATE ____

NOT IN STORES	ORDER PLACED	ORDER WRITTEN	REQ. APPROVED	REQUISITIONER

LAST ORDER PLACED WITH ____

QUANTITY ____ PRICE ____ ON HAND ____

ORDER CHECKED BY ____ ORDER SIGNED BY ____ PURCHASING AGENT

Figure 40. Purchase Requisition

5. The department ordering and the purpose for which the goods are intended should be stated.

6. The symbol or part number of each item should be given.

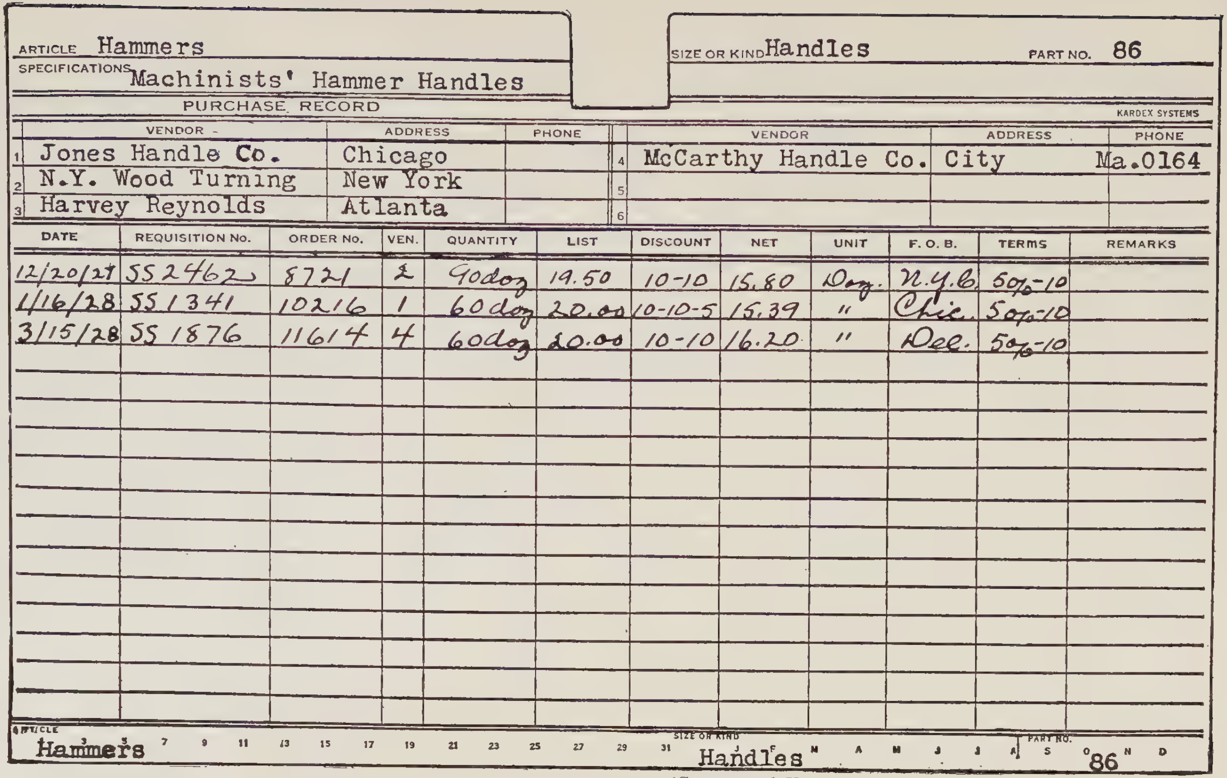
7. As the requisition is for the use of the purchasing agent in planning for and making the purchase, it should provide space for any information which will help him. The following items are ordinarily included: (a) Last cost of similar items. (b) Name of vendor recommended by the one making the requisition. This is done only in those cases where materials are especially desired from a certain vendor due to their superior quality. Ordinarily the purchasing agent selects the vendors and space is left on the requisition in which can be written the name of the vendor. The cost of the material when previously ordered, the name of vendor and other information needed will be secured from the purchase record. (c) Space for typing in purchase order number, f.o.b. point, terms of delivery, etc.

Figure 40 shows a purchase requisition form. Note that the requisition is zoned similar to the inquiry and the purchase order forms. This facilitates the writing of both the inquiry and the purchase order from the requisition. Those who make up requisitions do not, as a rule, word them very carefully and unless provided with suitable blanks they are apt to distribute important information throughout the body of the requisition where it is overlooked.

Purchase Record.—The purchase record is the history of transactions of the purchasing department and as such contains an ever-increasing fund of valuable information. The headings on the purchase record form illustrated in Figure 41 are self-explanatory. The column "Remarks" may be used to note any facts in regard to purchase, the kind of service rendered by the vendor, special features of quality, etc. Such information is invaluable in considering the placement of subsequent orders.

In order to call attention forcibly to any special features of a purchase that might otherwise be overlooked a system of colored signals is sometimes used. Thus, if a requisition came through for a certain material a signal on the purchase record may indicate that all such material is bought on contract only.

Quotations.—When time and conditions permit, quotations should be obtained from several vendors, care being taken, however, that all quote on the same specifications. Some companies prefer to ask for quotations by letter but a form similar to that



ARTICLE Hammers

SPECIFICATIONS Machinists' Hammer Handles

SIZE OR KIND Handles

PART NO. 86

PURCHASE RECORD

KARDEX SYSTEMS

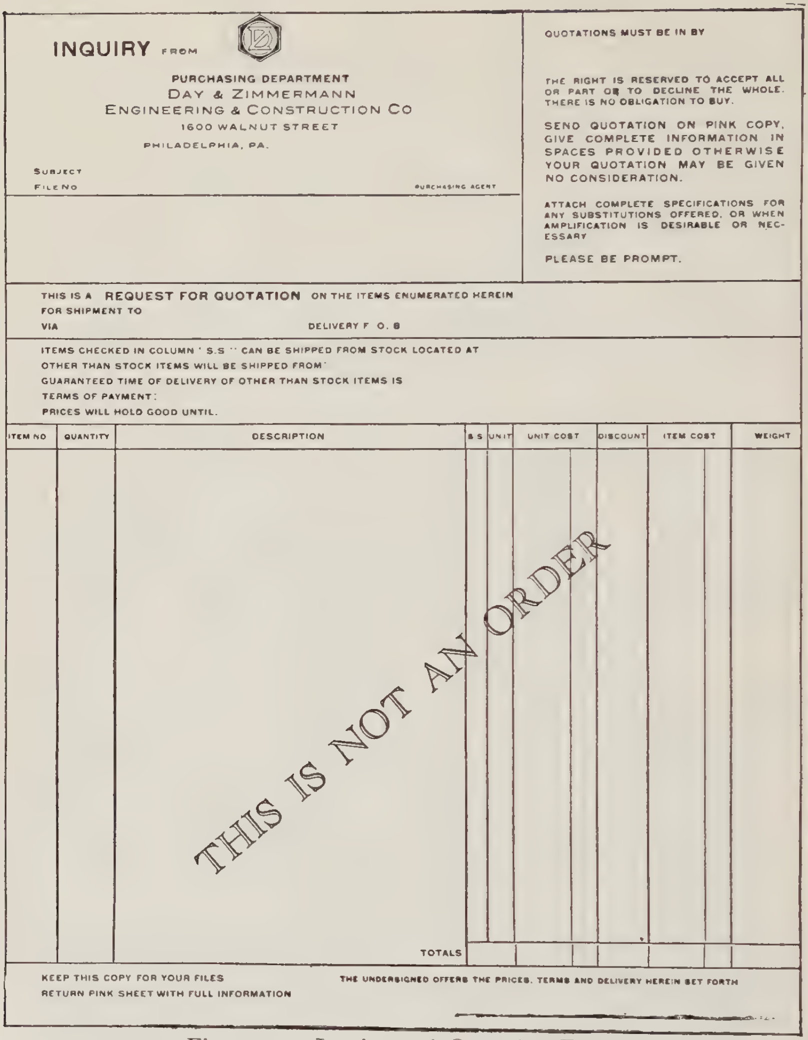
	VENDOR	ADDRESS	PHONE		VENDOR	ADDRESS	PHONE
1	Jones Handle Co.	Chicago		4	McCarthy Handle Co.	City	Ma.0164
2	N.Y. Wood Turning	New York		5			
3	Harvey Reynolds	Atlanta		6			

DATE	REQUISITION No.	ORDER No.	VEN.	QUANTITY	LIST	DISCOUNT	NET	UNIT	F. O. B.	TERMS	REMARKS
12/20/27	SS 2462	8721	2	90 doz	19.50	10-10	15.80	Doz.	N.Y.C.	5%-10	
1/16/28	SS 1341	10216	1	60 doz	20.00	10-10-5	15.39	"	Chic.	5%-10	
3/15/28	SS 1876	11614	4	60 doz	20.00	10-10	16.20	"	Del.	5%-10	

ARTICLE Hammers 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 SIZE OR KIND Handles J F M A M J J A S O N D PART NO. 86

(Courtesy of Kardex-Rand Company, Inc., Tonawanda, N. Y.)

Figure 41. Purchase Record Form



INQUIRY FROM

PURCHASING DEPARTMENT
DAY & ZIMMERMANN
ENGINEERING & CONSTRUCTION CO
1600 WALNUT STREET
PHILADELPHIA, PA.

SUBJECT
FILE NO
PURCHASING AGENT

QUOTATIONS MUST BE IN BY

THE RIGHT IS RESERVED TO ACCEPT ALL OR PART OR TO DECLINE THE WHOLE. THERE IS NO OBLIGATION TO BUY.

SEND QUOTATION ON PINK COPY. GIVE COMPLETE INFORMATION IN SPACES PROVIDED OTHERWISE YOUR QUOTATION MAY BE GIVEN NO CONSIDERATION.

ATTACH COMPLETE SPECIFICATIONS FOR ANY SUBSTITUTIONS OFFERED, OR WHEN AMPLIFICATION IS DESIRABLE OR NECESSARY

PLEASE BE PROMPT.

THIS IS A REQUEST FOR QUOTATION ON THE ITEMS ENUMERATED HEREIN
FOR SHIPMENT TO
VIA DELIVERY F. O. B

ITEMS CHECKED IN COLUMN " S.S " CAN BE SHIPPED FROM STOCK LOCATED AT
OTHER THAN STOCK ITEMS WILL BE SHIPPED FROM
GUARANTEED TIME OF DELIVERY OF OTHER THAN STOCK ITEMS IS
TERMS OF PAYMENT:
PRICES WILL HOLD GOOD UNTIL.

ITEM NO	QUANTITY	DESCRIPTION	S S	UNIT	UNIT COST	DISCOUNT	ITEM COST	WEIGHT
		THIS IS NOT AN ORDER						
		TOTALS						

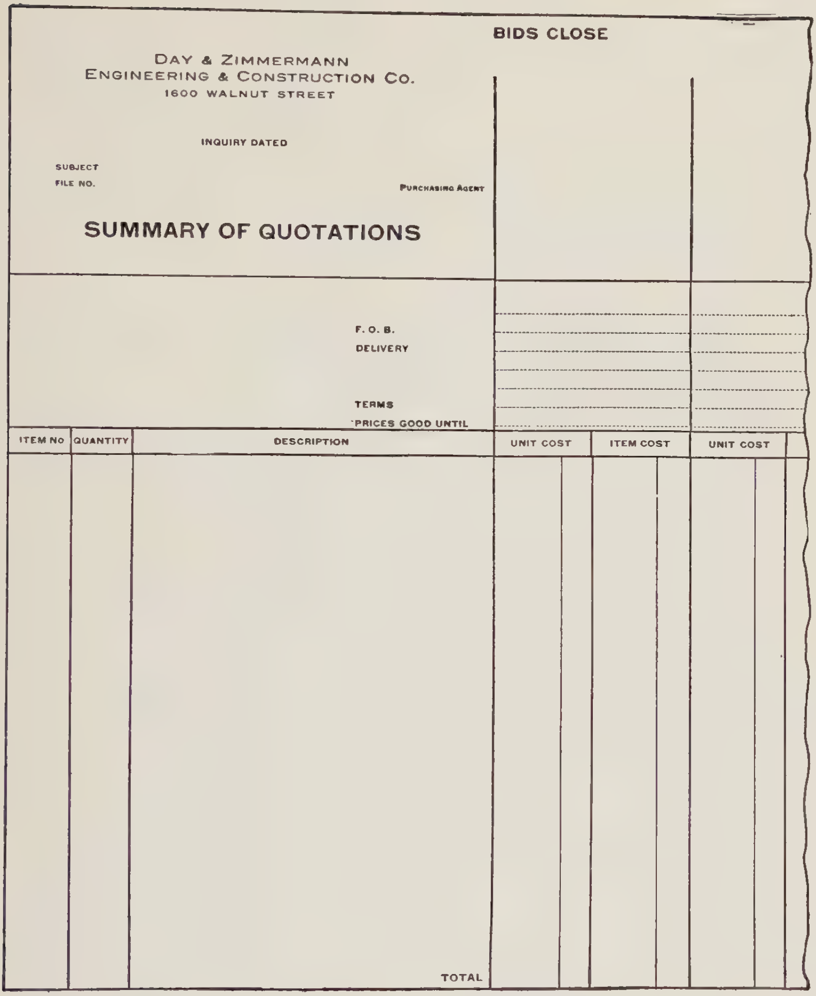
KEEP THIS COPY FOR YOUR FILES
RETURN PINK SHEET WITH FULL INFORMATION

THE UNDERSIGNED OFFERS THE PRICES, TERMS AND DELIVERY HEREIN SET FORTH

Figure 42. Inquiry and Quotation Form

shown in Figure 42 is ordinarily used. Emergency conditions sometimes prevent taking the time to ask for quotations but whenever possible it should be done in order to secure the lowest price consistent with quality of material and service rendered and to get a line on prices asked by the market in general.

In some concerns at the time the text of the inquiry is written, a



BIDS CLOSE

DAY & ZIMMERMANN
ENGINEERING & CONSTRUCTION CO.
1600 WALNUT STREET

INQUIRY DATED

SUBJECT
FILE NO.

PURCHASING AGENT

SUMMARY OF QUOTATIONS

F. O. B.
DELIVERY
TERMS
PRICES GOOD UNTIL

ITEM NO	QUANTITY	DESCRIPTION	UNIT COST	ITEM COST	UNIT COST
		TOTAL			

Figure 43. Summary of Quotations Form

carbon copy is made on a summary of quotations form (see Figure 43). The names of the firms to which an inquiry is sent are written in the spaces provided along the top of the summary form. As the quotations are returned, the data from them are entered on the form for comparison with quotations submitted by the other vendors.

All quotations received should be filed in quotation file for future reference. A simple alphabetical file, arranged according to the

names of the materials on which quotations have been secured, is ordinarily employed. The quotation file is of value in placing future orders and in case of question of the wisdom of the purchasing agent in placing an order. In instances where a purchasing agent has been unjustly accused of playing favoritism in the placement of orders the quotation file has many times justified his actions, whereas without such a file he might have had considerable difficulty in proving that his decisions have always been from an unbiased standpoint.

Purchase Order.—The purchase order duly filled out and signed becomes a legal contract and in case of disputes or litigation is the foundation of the company's claim. If sufficient detail is specified to make a complete statement of what is ordered, both as to quality and quantity, prices, discounts, terms, routing, date of delivery and any other conditions of purchase, the buyer is protected if the vendor does not live up to the agreement. It is important, therefore, that the purchase order be drawn up in a form that will eliminate, in so far as possible, chance of error and will make the actual writing of the order a simple clerical job. In order that each item of information will always be found in a definite place, the National Association of Purchasing Agents adopted a standard zone system as shown in Figure 44. The purchase order form shown in Figure 45 is designed to conform with the standard. The size of the form advocated is a sheet 8½ x 11 in. or 5 x 8 in. Several copies of the purchase order should be made, the exact number depending on the particular routine followed and the accounting system in use. A minimum number of four copies is ordinarily required as follows: (1) vendor, (2) purchasing department, (3) receiving division, and (4) accounting department.

In some concerns additional copies are made, for example, a copy to be sent to the requisitioner and a copy to be placed in the purchasing department follow-up file, all copies being distinguished by their colors. Where there is a planning division or production control system in use, the requisitioner is ordinarily the schedule order clerk and it is necessary that he know when orders have been placed. The need for this will be evident when the subject of production control is taken up in subsequent chapters.

The copy going to the vendor should have printed at the top "Pur-

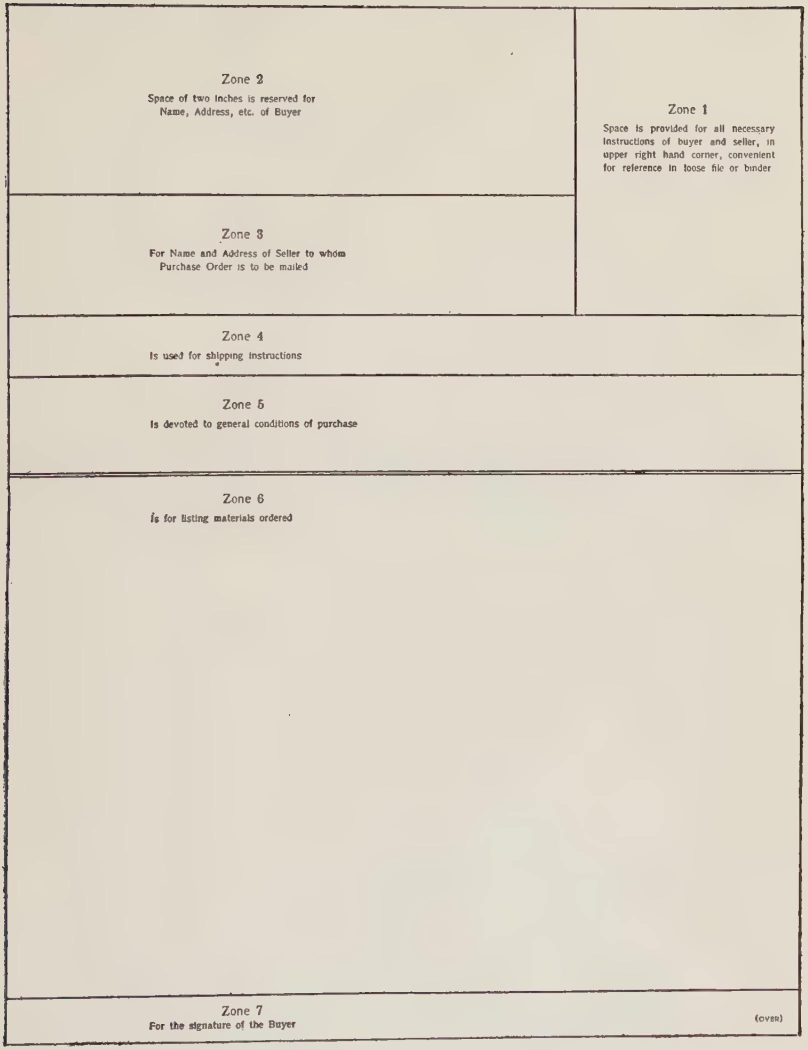


Figure 44. Standard Zone System Purchase Order Form

ORIGINAL
PURCHASE ORDER

LLENROC MANUFACTURING COMPANY
ITHACA, N. Y.

Our Order No.______

This order number must appear on invoice, B/L cases, bundles, packing lists and correspondence

Date______ 19____

Req. No.______

Your Order No.______

Mail invoice in DUPLICATE and original B/L to

______

______

Please ship the following subject to conditions below:

Ship to — Ship via

Date to be shipped — Terms — F. O. B.

CONDITIONS

No charge allowed for boxing, packing or cartage.
No goods to be charged at higher price than last without notice first being given to us.
All prices are F.O.B. destination unless otherwise specified.
Goods subject to our inspection, notwithstanding prior payment to obtain cash discount.
Goods rejected on account of inferior quality or workmanship will be returned to you with charges for transportation both ways plus labor, reloading, trucking, etc., and are not to be replaced except upon receipt of written instructions from us.
We reserve the right to cancel if order is not shipped on date specified. In case of order calling for partial shipments, balance may be cancelled or suspended by us if shipments are not made on date specified.
It is understood that in accepting this order you hereby covenant and agree to defend and save harmless Llenroc Manufacturing Company against any and all claims which may be made under Patent Laws of the United States on account of the manufacture, sale or use of the articles within named and likewise of any other article furnished pursuant thereto.
You are to assume all liability for all damage or injury caused by or to your workmen while engaged in the execution of this order.
This order is accepted in accordance with conditions of sale mentioned hereon.

QUANTITY	DESCRIPTION	UNIT PRICE	TOTAL

LLENROC MANUFACTURING COMPANY
per______
Purchasing Agent

Figure 45. A Purchase Order Form (conforming with N.A.P.A. Standard Zoning System)

chase Order." The other copies should have printed at the top the names of those who are to receive them, such as "Receiving Clerk's Copy," "Stock Clerk's Copy," etc. This will prevent confusion and facilitate the distribution of copies.

When the purchasing agent makes a contract for future requirements, of a certain material involving a considerable sum and specifications based upon technical data, a standard contract should be used.

Acknowledgment of Purchase Orders.—Acknowledgment should be made of all orders. The form provided for acknowledgment varies. Some concerns send an extra copy of the purchase order to the vendor, suitably printed for acknowledgment and with a space provided in which the vendor can state the time shipment is expected to be made. Other concerns advocate an attached perforated slip at the bottom of the vendor's copy of the purchase order which gives the order number and date and leaves a space for the vendor to acknowledge the order and specify the date of shipment. Still other concerns include with the purchase order to the vendor a self-addressed post-card or other acknowledgment form with the above data on it.

Invoice.—When the vendor has shipped the goods and so fulfilled his part of the purchase contract he immediately sends by mail an invoice to the purchaser. It is then the duty of the purchasing department to check the invoice with the purchase order as to price, f.o.b. point, terms, etc., and with the materials received report as to quantity and quality. The materials received report is ordinarily the receiving clerk's copy of the purchase order properly checked as to materials received. The quantities ordered are frequently left off of the receiving clerk's copy of the purchase order so that the clerk will have to count the shipment and not simply guess the number is correct and "let it go at that." It is then the duty of the clerk in the purchasing department who checks the invoice to see that the number received and the number ordered check and that the goods have been inspected as to quality and checked as approved by the inspector. In cases where the head of the receiving department does not check the incoming shipments himself the quantity ordered is typed on his copy of the purchase order for his information.

When there is a discrepancy in quality or quantity the purchasing

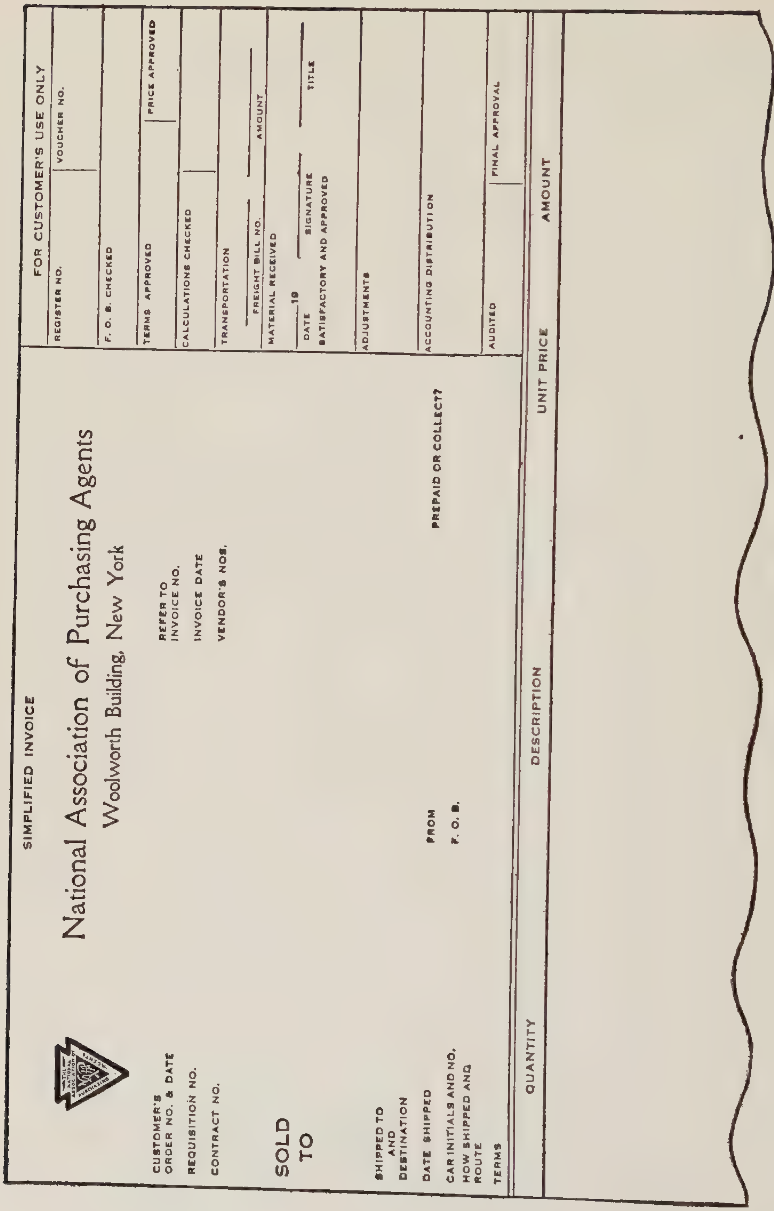


Figure 46. Invoice Form

agent notifies the vendor and ordinarily payment is withheld until the matter is adjusted. When the vendor is a reliable firm with whom business dealings have always been perfectly satisfactory in the past the invoice may be paid in full knowing that proper adjustment will be made.

When shipment has been fully in accordance with the specifications and terms given in the purchase order the purchasing agent approves the invoice and immediately forwards it to the accounting division so that advantage may be taken of any discount rate.

Figure 46 illustrates the simplified invoice endorsed by the Division of Simplified Practice, Department of Commerce, Washington, D. C., on February 16, 1927. The following suggestions are given so that a company's invoice may conform to the standard.

"Customer's Use" block must be exactly as shown.
Designations must all be shown.
Sequence and position of designations must be as shown.
Sizes—8½" from side to side.

7", 11", 14" } from top to bottom.

Optional for User's Convenience.

Size and arrangement of space for vendor's name, address, trade mark, etc., may be changed as desired.
Spacing both horizontal and vertical, to left of "Customer's Use" block, may be changed as desired,
"Shipped To and Destination" may be arranged for window envelope.
"Quantity","Description","Price" and "Amount" columns may be subdivided as desired.
Invoices to retailers should provide a column ⅞" wide to the right of the "Amount" column and headed "For Retailer's Use."

ADVANTAGES

Eliminates misunderstandings and inconveniences.
Expedites shipments and the settlement of accounts.

SAVES
- money by reducing clerical personnel.
- paper by cutting from standard size stock without waste.
- correspondence by including all necessary information on the forms themselves.
- time in filing, finding and handling while being checked.
- filing space through uniformity of size.

Unites the support of the proponents of earlier forms,

Purchasing Policy

Standardization of the Materials and Supplies Purchased.—One of the most common and most costly errors in purchasing is the

buying of too many varieties which results in tying up unnecessary capital in inventories and invariably heavy, ultimate loss due to obsolescence. This condition usually is due to a lack of coordination of the engineering, maintenance and purchasing functions and of cooperation between the personnel of the departments in charge of those functions. It is the function of the engineering department to determine the specifications of the materials which enter into the product and its fabrication. It is the responsibility of the head of that department, therefore, if a great number of varieties are specified when with a little thought and planning and perhaps a slight change in design a comparatively few varieties would meet all needs equally well. Similarly the maintenance division specifies the supplies and materials needed for maintenance and repairs. The head of that division is responsible therefore if through a whim or fancy a variety of supplies and materials is specified when many of the items required could be standardized and only the standard article purchased. The purchasing agent, however, who fully appreciates the responsibility of his position, can diplomatically suggest, when a new variety is asked for, whether one already in stock would not suit the needs equally well. If he is tactful in making suggestions he will ordinarily find that the heads of both the engineering department and the maintenance division are open to all worthwhile suggestions especially if he points out to them the advantages to be gained.

Hand-to-Mouth Buying vs. Buying to Stock.—Hand-to-mouth buying is a misnomer for the more conservative buying—the buying of small quantities more often—in contrast to laying in large stocks or placing contracts a long way in advance. Hand-to-mouth buying, coming as a result of and to counteract the evils of inflation, has brought with it many benefits to industry but, due to its being carried too far in many cases, has had accompanying disadvantages. The following discussion is intended to bring out the advantages and disadvantages and to point out the wisdom of following a middle course in purchasing rather than to go to extremes.

Advantages of Hand-to-Mouth Buying.—

1. Hand-to-mouth buying reduces the amount of capital tied up in inventories resulting in a saving in interest on investment and

the release of capital which can then be used for active production work. Eugene G. Grace, in an article on "Distributed Prosperity," [1] stated that "the release of capital,—the transfer of millions from idle shelves to active factories—has been a potent factor in the distribution of prosperity." He further stated that the Bethlehem Steel Corporation had completed a $35,000,000 new construction program made possible without borrowing by sharp reductions in inventories. In 1923, the Bethlehem Steel Corporation had a material account of $90,000,000; by the end of 1925 while still doing the same amount of business it was reduced to $69,000,000. In other words, they did the same amount of business on $21,000,000 less capital. Mr. Grace cited similar instances in reductions in material and stores account while doing the same or greater business for the Pennsylvania Railroad, New York Central, Baltimore and Ohio and Union Pacific, the reductions ranging from $20,000,000 to $70,000,000 a year. Reduced inventories in addition to permitting of maximum use of capital reduces the danger of loss through obsolescence of stocked materials, a big factor in this age of constant improvement, and releases valuable space for productive work.

2. Purchase requirements can be more accurately and definitely determined and so fit in better with the budget requirements.

3. The purchaser guards himself against price fluctuations. When orders are placed far in advance of consumption needs the purchaser stands to lose in case the price drops between the time the order is placed and the time the goods are required.

4. Due to not having large stocks on hand which must be used the purchaser can take advantage of any market conditions favorable to him, such as buying at a reduced figure from a plant that is overproduced.

5. Brings about a closer relationship between buyer and seller due to increased number of salesman's calls and the placing of orders at more frequent intervals.

6. There is an economic gain through shortening the road from raw materials to consumption.

7. There is a most decided advantage to the seller and indeed to all industry through reducing seasonal production. Purchases being more uniform throughout the year, industry becomes more stable and production peaks and valleys tend to smooth out. This reduces sea-

[1] *Saturday Evening Post,* September 4, 1926.

sonal unemployment with its hardship to employees, and its cost to the employer through idle machinery, decreased efficiency, and general demoralizing effect.

Disadvantages of Hand-to-Mouth Buying.—

1. Increased cost of materials per unit due to buying in small quantities thereby losing the quantity discount. The larger the quantity ordered the lower the price per unit up to a certain quantity.

2. Increased distribution costs due to: (a) Increased number of salesmen's calls. (b) Increased number of credit extensions. (c) Increased cost of packing. A number of small orders costs more to pack than a fewer number of large orders. Likewise standard boxes or crates cannot be used in many instances as one concern may order 10 units, another 25 units, and so on, whereas before hand-to-mouth buying was inaugurated case lots were ordered. (d) Increased clerical cost.

As distribution costs must be passed on to the consumer it is apparent where one of the evils of hand-to-mouth buying lies when the practice is carried too far.

An interesting article, "Competition That Raises Prices,"[2] told of a study made by a manufacturer to find out the effect upon his profits of having to fill so many small orders. He found there were required the following ten steps to execute an order:

"1. Enter order.
2. Make out acknowledgment and mail.
3. Tabulate to factory production record.
4. Tabulate to customer's order record.
5. Take items from stock.
6. Pack specially instead of in standard cases. This involves extra cost for a small shipping case and extra labor in packing, besides extra weight in proportion to the contents when paying for freight.
7. Secure bill of lading or express receipt or parcel post receipt.
8. Make out invoice and mail to customer.
9. Post invoice in ledger.
10. Post payment when received."

[2] Fayette R. Plumb as told to Charles C. Muller, *Saturday Evening Post*, May 21, 1927, p. 66.

The manufacturer found that "the cost of these ten steps amounted to more than $2.50 per order. This was 10% of an order of $25, and on some of the smaller parcel post shipments amounted to more than the selling price." A wholesaler handling the products of the above manufacturer then made a similar study and reported: "The study of our office and warehouse salaries showed that it cost for labor alone just one dollar an order and that the average total cost of handling each order was about $3.50." The above figures no doubt explain at least part of the high cost of distribution all of which ultimately is paid by the consumer.

3. Increased costs due to: (a) Unpacking and putting into stock a large number of small orders. (b) Increased office and other expense due to additional ordering, recording, checking, inspecting and the other items incident to placing an order and receiving and paying for the goods.

4. If the plant is not working under an effective system of production control, production may be held up due to failure of delivery of raw materials resulting in idle machinery, lost time on the part of the workers, decreased production and loss of sales.

5. L. J. Belnap, president of Worthington Pump and Machinery Corporation,[3] brings out another evil if hand-to-mouth buying is carried to extreme. "If hand-to-mouth buying increases, it is going to have a tendency to restrict far-sightedness and vision on the part of consumers, particularly those who should give ample time for designing, laying out, and planning of projected improvements, which eventually may increase the cost and decrease the efficiency."

In order to have the work of the purchasing department most effective a common sense policy of purchasing is probably the best course for the average manufacturer to pursue. Through a material control system it can be definitely known what materials and how much of each will be needed in any given period. There should then be determined for each article carried in stock a minimum quantity below which stock under ordinary circumstances should not be allowed to fall and a maximum quantity above which it should not be permitted to rise. The purchasing agent can then make his purchases within these limits, conforming at all times with the trends prevailing in the market. He will thus keep the stock as low as safety permits when prices are high, near the peak or declining and

[3] L. J. Belnap, *Factory,* A. W. Shaw Company, Jan., 1927, p. 63.

conversely carry a maximum stock when prices are low and the market is advancing. He thus buys hand-to-mouth when commodity prices are high or declining and purchases more heavily when prices are low or advancing and so reaps the benefit of each method by using it when it is to his advantage to do so.

Foresight on the part of the purchasing agent in purchasing raw materials gives a big advantage to the concern over its competitors who do not so closely follow the market or who do not adopt the common sense policy of only buying according to definite anticipated needs and between fixed limits. Many a business man will speculate in raw materials when he would be horrified at the very thought of speculating on the stock market or gambling in the ordinary sense of the word. The speculator may reap large profits by heavy forward buying but he can just as readily suffer a ruinous loss if the market declines. Few if any of us can always anticipate correctly market changes and the wise manufacturer leaves speculation to the speculators and confines himself to his own field. Speculation and overconservative buying both should be avoided. The former at best brings anxiety and unstable profits, the latter brings the danger of costly shut-downs due to lack of materials. Suppliers are human, errors are bound to creep in and delays occur for one cause or another or shipments are lost or delayed in transit. The solution is a common sense policy—purchasing sufficient for all needs but never overstocking or carrying stocks dangerously low.

CHAPTER XVI

STORESKEEPING

Necessity for Material Control.—Capital in the form of money or securities is very carefully guarded. Those in charge must render an accounting for every penny. Capital in the form of materials, equipment, tools and supplies is rarely so carefully guarded, and in fact is frequently unprotected. Accounting for stores in many cases is most inefficient with little or no idea as to when stores are used, by whom they are used or for what purpose they are used.

The lack of adequate control of materials, resulting in an unbalanced stock with its accompanying evils, is frequently a weak spot in an otherwise strong organization. Valuable material taken from stores without authority or record of how the material is used results in more than simply a waste of capital in the form of material. Such a slipshod method tends to undermine the morale of the working force. When work is spoiled the worker throws it away as scrap or conceals it behind a convenient work bench or locker. He then draws out more raw material. This encourages carelessness and lack of responsibility in the worker. He does not appreciate the cash value of the raw material. If it were money, a dollar bill for example, he would feel he should care for it and account for it. A casting or perhaps a forging for a crankshaft, costing many times the value of the dollar bill, he might not have the same respect for. He would probably think, "What's the use? There are plenty more where that came from." The fault in such a case does not lie with the worker. It lies with the management. If when a worker wants a piece of wood, he goes to stock and draws out a nice, fresh 2 x 4, when he has other pieces of wood at his bench that would do, the management is at fault. It is human nature to want to use new material just as a piece of pie from a whole pie seems to taste better than a piece of equal size and quality from a part of a pie.

The remedy for such conditions is a simple yet adequate system of material control. Material control as here considered covers the control of materials from the determination of materials required to

the issuance of materials upon requisition to the proper person and the accounting of goods issued to the production order. An adequate system of material control safeguards and accounts for all materials and acts as a valuable tool of both production and cost.

Advantages Derived Through Material Control.—The following are some of the advantages gained from an accurate and intelligent control of materials:

1. *Prevents losses through check of all incoming materials as to quantity and quality and agreement with all conditions specified on the purchase order.* Where the materials received are standard items regularly carried in stock counting may be sufficient. Where there is a chance for some of the materials to be off grade or where mechanical or electrical performance or exact chemical composition is in question then a thorough inspection should be given to determine quality as well as quantity. The extent to which inspection of incoming materials should be carried depends upon the nature of the materials. The quality of the ultimate product can be no better than the materials that entered into it. Therefore inspection of those materials is important, not only to guard against loss due to misrepresentation of quality or short count on the part of the vendor, or to breakage and damage in transit, but to make sure that the proper quality of material is entering into the product. Yet, inspection should not be carried past the point where it is profitable. Count and test of each screw in a shipment of screws would be just as regardless of consequences of cost as it would be foolhardy to count a hundred motors and accept them as ordered with no further inspection or to accept a large consignment of rubber, leather or silk with no further inspection of the order except to see that the correct number of pounds or yards had been received. A system of material control that is suited for the needs of the particular concern for which it has been adopted provides for the inspection that is needed, varying the amount and extent of inspection with the nature of the materials received. A more thorough discussion of the subject of inspection and its importance is covered in Chapter XXII.

2. *Tends to eliminate waste of materials due to theft, breakage, deterioration due to the elements, etc., and of space due to improper location and arrangement of materials stored.* A proper system of material control provides for adequate protection and storage of all

materials. Storage is taken care of in a systematic manner conserving space and arranging materials so that they are at all times readily available for use. Just in the matter of caring for miscellaneous supplies, alone, the storeroom may pay for itself. Many a worker who would not think of taking even five cents from a cash drawer would not hesitate to take for his own use a brush, a bar of soap, or a few sheets of sandpaper. Buying no more materials or supplies than are needed, rationing them out or issuing them with discretion are some of the ways provided under a system of material control to eliminate waste of materials and supplies.

3. *Prevents overbuying and tying up of capital in inventories.* Stock on hand is kept at a minimum consistent with production requirements and purchase market conditions. The importance of keeping inventories down to reasonable limits is appreciated after our discussion of purchasing in the previous chapter, hence needs no further comment here.

4. *Aids in cutting down needless variety.* Slow-moving and low consumption items are noted and the use of regular standard items suggested in their place. Likewise, when a new article or material is asked for, endeavor is made to see whether a material on hand will not be just as satisfactory Where stocks of obsolete or slow-moving materials have accumulated due to an unexpected change in the design of the product necessitating a change in materials or some similar occurrence, such stocks are gradually worked off by substituting them for other materials asked for when they will serve the purpose equally as well and the one making the requisition has no objection. This tends to minimize losses due to obsolescence of materials which would ordinarily have to be sold as scrap.

5. *Prevents production delays from lack of materials by supplying the materials in the manner and amount requested at the time required.* Under a system of material control it is definitely known just how much of each kind of material is needed to produce a specified number of the product and in what manner it should be delivered —in a tote-pan, dolly box, on a rack or in what other way best to facilitate production. Material is then provided in accordance with the production schedule. Stocks are thus kept balanced and production delays and shut-downs, due to shortage of materials are eliminated. In those concerns where there is no adequate system of material control it is not at all uncommon to have a serious delay in

production due to a shortage of some relatively unimportant material, the need of which has been overlooked. This may result in being unable to make delivery to an important customer and subsequent loss of his business. Such occurrences are ordinarily put down to "hard luck" instead of the true reason "slipshod methods." In addition a material control system relieves the foreman or department head from having to keep track of materials he has ordered and of the worry over whether or not the goods ordered will be on hand when he needs them. Material control is another example of specialization. It is the control of materials by experts relieving the operating men of all work in connection with stores and so leaving them free for their own specialized duty—the fabrication of the product.

6. *An adequate system of material control includes a perpetual inventory.* This tends to do away with the old costly and burdensome periodic physical inventory. Inventory time is the bugbear of many a plant. Inventory taking is regarded as something to be done as seldom as possible and then to be gotten over as quickly as possible only too frequently by making a guess at how many are in a particular bin or storage place or by counting a few and lumping the remainder. Such a method cannot help but lead to waste and encourage inefficiency and dishonesty. When a periodic physical count is depended upon entirely the concern rarely knows what it has in stock. Stock taking times are too far apart for the records to be of current use.

One of the large automobile plants in the period of high prices and shortage of many materials shortly after the close of the World War went to considerable trouble to find a substitute for a material they required the cost of which had become prohibitive. Shortly after they had contracted for and had begun to receive deliveries on a substitute that was very inferior and yet at a price higher than they had been accustomed to pay for the real article, one of the men in cleaning up a storeroom found over in a dark part of the room behind a lot of obsolete stock, a large quantity of the regular material sufficient to meet all requirements for a six months period or longer. A perpetual inventory would have revealed this material in stock and vast quantities of other equally valuable materials much of which had deteriorated or become obsolete. As it was the investigation and general clean-up which followed showed a heavy, unnecessary inventory and pointed to one of the causes of the un-

stable financial condition of the company. The amount that had to be written off the books due to obsolescence, deterioration and depreciation of stocks ran up into the hundreds of thousands. An adequate system of material control such as was later installed would have prevented such losses.

7. *Aids in accounting for materials.* The records of a material control system afford a check on materials received against purchase requisition and purchase order, a check of materials issued against estimated materials required for the volume produced and, in addition, serve as a basis for the allocation of the cost of materials to the proper division, product, job or process and the determination of what part of this cost is due to scrap or defective material. Where materials used are inexpensive there is likely to be the attitude that the value of the material does not justify keeping track of it. Simple, inexpensive methods of keeping accurate check on materials, however, can be devised and should be used.

Location of the Storeroom.—Wherever practicable, materials should be stored near the point of usage so as to save time and handling. It is frequently advisable to have several smaller storerooms in addition to the general storeroom, each subsidiary storeroom taking care of the material requirements for certain sections. Centralized control in such a case is maintained by having a general storeskeeper in charge of the storeskeeping function and a storeskeeper responsible to him in charge of each of the subsidiary storerooms. The location and number of storerooms will depend primarily upon the four following factors:

1. *The nature, value, consumption and volume of the materials stored.*

(a) Under the heading "nature of materials" should be considered the question of inflammability and explosiveness. Materials of such a nature should be stored in a fireproof building isolated from the main factory buildings. This method is not only safer but, in reality, is ordinarily cheaper as insurance rates are high for buildings containing materials which increase the risk of fire or explosion. Paints, varnish, oils and gasoline, are among some of the more common materials which can be classed under this heading.

The bulkiness of materials is another question to be considered. Where materials are of a bulky nature they are frequently stored

out in the yard so as not to take up valuable floor space. In so doing, however, care should be used to prevent deterioration due to the elements. To pile high-grade steel bars out in the yard may save floor space but it is a costly saving if the bars rust and cannot be used. Steel is heavy and it is human nature to do work in the easiest possible way—to place new bars when received on top of the pile and likewise to take off what is needed from the top. It is at once evident what happens to the bars on the bottom in the due course of time. Such waste could be eliminated by building a suitable shed for protection and by partitioning it off into bins or racks thus separating steel newly received from that which is in stock and always using up the stock that has been on hand longest.

Other influencing factors in the location of a storeroom are the particular conditions of temperature, light, moisture, etc., required properly to care for various materials. Materials which absorb moisture such as cement, should be stored where it is dry. Liquids which have to be protected against freezing should be stored in a heated storeroom and so on. All of these conditions add to the problem of proper storage.

(b) The value of the materials stored is another important factor in the location of storerooms. Pig iron, the cost of which is comparatively low, requires little protection and can be stored anywhere that space is available. Magnetos which are of considerable value should be carefully taken care of. It may be a temptation to some of the workers to take one or two of them home, as every automobile requires a magneto and if the worker's car does not need a new one perhaps one of his friends could use it.

One of the large motor car companies had numerous reports coming to them of workmen offering magnetos for sale at a very low price. Inquiry showed that some of the workmen took a short cut out of the plant at night by going through one of the traffic tunnels and out through the storeroom. The storeroom doors were frequently left unlocked by the storeskeeper who was always one of the first men to leave at night, being the type of man who likes to "beat the whistle." The doors were made self-closing and self-locking and no person allowed to enter the storeroom unless attended by the storeskeeper or one of his assistants. The storeskeeper was made responsible for the proper care and account of materials and under

this new order of things magnetos and other valuable materials stopped disappearing.

(c) Materials in greatest demand should be placed in the most accessible location leaving materials little used in another storeroom more remote or perhaps in the basement.

(d) Where the volume of materials is large they would take up too much valuable floor space if stored in the factory building, so some provision must be made to store them, properly protected, either in the yard or in the basement. Where the basement is dry and is suitably constructed and finished, it forms an ideal storage space especially for the great bulk of the materials. Frequently the basement is used as a reservoir with small storerooms upstairs in different shops or production rooms convenient to the workers, the stock in the small room being replenished frequently. This not only keeps material readily accessible at a low cost of floor space consumption but relieves any possible building strain due to undue weight upon ceilings below. With advantage taken of gravity conveyors and other modern material handling equipment the transfer of materials from the receiving room to the basement storeroom and back again from the basement storeroom to the small storerooms in the shops can be very readily made at low cost.

2. *The size and type of buildings.* Where the plant is spread out over a large area there will probably have to be a number of storerooms conveniently located, each carrying the materials used by the shops to which it is adjacent. If the plant is housed in one large single-story building a general storeroom is sometimes located in the center with the manufacturing shops surrounding it. In that way it can serve all shops and at the same time takes up the least desirable floor space, the interior being usually not so well lighted. Where the building is several stories in height materials are usually stored in the basement or on the first floor, the material being taken to the proper upper floor as needed or auxiliary storerooms are located on each floor to supply the needs of that floor. Where materials are heavy storage in the basement or first floor is always desirable as construction strong enough to carry heavy loads is quite expensive and if the building is not suitably constructed and too heavy loads are carried the building cannot stand the strain and serious accidents may result.

3. *The layout of the manufacturing sections and their relative*

material requirements. Raw materials, worked materials and finished parts should be stored where convenient to the manufacturing sections requiring them. (See Figure 12.)

4. *The space available.* In the end the location of any storeroom resolves down to the available space. All factors involved should be carefully analyzed and weighed, and the possibilities of the several spaces available evaluated so as to secure the best location conditions will permit. In location of a storeroom, as in many, if not in all business problems, a continual compromise must be made, the ideal location being always borne in mind, however, so that as near to the ideal can be reached as working conditions permit.

Layout of the Storeroom.—In arranging the layout of a storeroom adequate space should be allowed for each of the following:

1. Actual storage of goods.

2. Receipt and check of incoming materials.

3. Issuing materials. In many cases the confusion and delay of rush hours can be eliminated through setting aside sufficient space so that the storeskeeper can fill the material requisitions in advance and hold the materials ready for delivery.

4. Aisles to permit easy access to all materials. In case of heavy materials aisles should be wide enough for the use of a truck.

Arrangement of Materials in Storeroom.—Materials are arranged according to convenience in handling and storing and the frequency of issue. It is merely applying common sense to store heaviest materials on or near the floor, lighter materials above and to locate inactive materials in the less accessible places where they will interfere least with active stock and the ease of handling materials.

The motto for every storeroom should be the old maxim, "A place for everything and everything in its place." Only too often materials received are dumped here, there and everywhere with the result that the storeskeeper is a harassed individual continually hunting for something that is wanted in a hurry but cannot be found. Probably it is lying in a corner where it was dumped, with other materials, received later, piled in confusion on top of it. It is no wonder stocks cannot be found and production is delayed. This slipshod condition is all too common and results from the lack of appreciation of the value of proper storeskeeping. Materials should always be stored in an orderly manner following a definite plan

which has been worked out to fit the conditions peculiar to the particular stockroom. Regular items of stock should be given a permanent storeroom location. Other items should be given a location only when required and that location properly indexed, otherwise valuable storage space will be continually held in reserve when it should be in active use. Ease and speed in locating materials, accessibility, economy of space and a minimum of handling are the essential requirements in arranging materials.

In this connection it might be well to mention what should be self-evident but is many times neglected in practice. When materials are obsolete and cannot be used in the plant they should be sold or if there is no market for them they should be given away or destroyed. Many a crowded storeroom, which may give an appearance of a fine stock is in reality literally clogged with obsolete stock which is only using up space required for materials in everyday use. It is foolish economy to hoard materials with the thought, "I may need them some day." Overhead charges are too high, storerooms become congested and issuance of materials is delayed. All obsolete stock should be studied to see whether it cannot be utilized in the plant and if not it should be disposed of as advantageously as possible. Contrary to popular belief, a big stock does not necessarily mean the same thing as so much money. Its value all depends on how efficient the purchasing has been and how large a portion of the stock can be utilized. As one storeskeeper put it, "Our manager thinks our storeroom looks fine because it is in order and all the shelves are chucked full. I wish he would let me make a house cleaning. Half of the stuff we have has not been used in years and how I do need the room. We are so crowded it takes twice as long to get out orders as it should and the men complain when they have to wait." This is an old story in many storerooms.

There are two main ways of arranging a storeroom: (1) by index; (2) by classification. In deciding upon the method of arrangement it should be taken into consideration whether the goods are:

1. Raw materials and supplies—for example, bar steel, screws, nuts, bolts, etc.
2. Worked materials—for example, castings, crankshafts, etc. Parts awaiting another operation or to be assembled.
3. Finished goods commonly spoken of as finished stores.

A system that will work well in one storeroom may not work in another due to the type of goods stored. Where the goods stored are parts it may be advisable to arrange the parts by part numbers, grouping those parts which go into a particular assembly in a certain section of the storeroom. As, by a little thought on the part of the engineering department, all parts of an assembly can be assigned related or similar part numbers, storing and issue of parts can be greatly facilitated. Thus, if a stores requisition calls for all parts needed for a certain assembly, the storeskeeper can very readily furnish the parts without hunting all over the storeroom.

When materials are arranged by the index method the materials are stored where most convenient and an index of material location kept. Thus if there were more than one storeroom, each storeroom might be designated by a Roman numeral: I, II, III, IV. Each section in a storeroom might be assigned a capital letter: A, B, C, etc. Each row might be assigned an Arabic number: 1, 2, and finally each bin a small letter of the alphabet. For example, if the index record indicates that a given article is located at VA4w, it is known instantly that the material is in Storeroom V, Section A, row 4, bin w. In some storerooms rows and bins may both be given numbers, the first digit indicating the row, the latter digit the bin.

When the index system is used it may be desirable to have an index board conveniently located in each storeroom. On the index board would appear in logical sequence the symbols of all items stored and their location in the room.

Classification and Symbolization.—In the average plant a variety of materials and supplies is ordinarily carried in stock. The first step in classifying and symbolizing these materials is to standardize them if that has not already been done. Standardization is appreciated when one begins to classify materials and to assign symbols, for the folly of having any more classifications and symbols to designate those classifications than are absolutely necessary is at once evident. Thus, the indirect advantage of classification in encouraging standardization is frequently as great an advantage in reducing costs and increasing general plant efficiency as are the more direct advantages in facilitating storage and issuance.

Materials are classified according to their nature or to the use to which they are put. With the mnemonic system of symbolization

the letters of the alphabet are used omitting I, O, and Q, so as to avoid possible confusion with the numbers 1, 0, 2. Numbers are used to indicate sizes. All like items are grouped into a main class and designated by the letter which suggests the name of the material by its sound. Where possible the initial letter is used as, for example, the letter S is used to represent all "Stores," the letter P is assigned to "Pipes." Each main group is then subdivided as often as is necessary and the proper symbol assigned, as for example:

S = Stores
SP = Iron pipes and fittings
SPB = Bushings (A form of iron fitting)

Symbols are assigned to aid in the recognition of the item and to identify it from all other items. Names could be used but a name to one person may mean one thing and to another person it may mean something quite different. Again, in order to have a name accurately describe a certain material it may have to consist of a half-dozen words or more, whereas with symbols that many letters or less would be sufficient. A symbol is more accurate, shorter and gives less chance for question or error.

Arrangement by Symbols.—When the materials or parts are classified and symbols assigned according to the mnemonic method, materials or parts should be arranged in the storeroom in that same order. In the first section should be placed all materials or parts the symbols of which begin with B or whatever the first letter is; in the last section all materials the symbols of which begin with W or whatever the last letter may be. The intermediate sections should be arranged in alphabetical order, with the racks, drawers or bins within each section similarly arranged alphabetically. Thus, one section may be marked SESA–SESP. If a stock requisition were sent in for 25 SES2D the storeskeeper would immediately go to the section SESA-SESP rack D bin 2 and find the 25 large brass pull sockets the requisition asked for.[1]

When numerical symbolization is employed numbers are used in

[1] SE – Electrical supplies.
SES – Electrical sockets and forks.
SESD – Brass pull sockets.
SES2D – Large brass pull sockets.
The size is indicated by the number 2 as sizes ordinarily are indicated by numbers.

place of letters. Nothing in the symbol, however, recalls the material or part referred to which is a decided disadvantage although daily association of the material or part and the symbol in time overcomes this. For concerns having a great variety of materials the numerical system has the disadvantage of only providing 10 class divisions in place of the 23 divisions in the mnemonic system. Numerical symbolization is successfully employed in some concerns chiefly those manufacturing a few standard products necessitating but a limited number of standard materials. Ordinarily, the mnemonic system is found more suitable.

Stores classification and symbolization is merely one phase of the broad field of industrial classification. Classification and symbolization are nothing new or complicated. Classification in industry is merely the analysis of a business or a particular phase of business and the grouping together in a logical manner of all items having similar characteristics. Symbols are the characters used to indicate the classified items and have been aptly termed the shorthand of classification. They may consist of letters, numbers or signs or a combination of letters and numbers according to the method employed. They are necessary for definiteness and brevity. A symbol means one thing and one thing only.

Classification is indispensable in modern industry. The need for a well-planned and adequate system of classification is probably most apparent in accounting where a classification of accounts is necessary in finding and controlling costs. All possible sources of expense are listed, analyzed and grouped into a number of main classes. Each main class is then subdivided as far as necessary. Thus one main class may be sales expense which would be subdivided into salesmen's salaries, advertising expense, traveling expense, etc. Similarly with purchasing expense, manufacturing expense and the other main classes of expense in a business. The benefits to be derived from such a system of classification of costs are at once evident. They hold true, although probably not to quite so great an extent, in other phases of business. For example, in planning production in a large assembly plant a system of classification and symbolization furnishes a means of routing and controlling materials in process by identifying and designating all materials, machines, workplaces and operations in a process.

Equipment Required.—The storeroom equipment should be uniform and adapted to suit the particular needs. The multiple unit plan of bin arrangement is most desirable due to its flexibility. Under such an arrangement bins can be subdivided to meet varying needs by inserting standard units.

The required bins, drawers, racks and shelves can be made of either wood or steel. Wood is cheaper but steel affords more

(Courtesy of David Lupton's Sons Co., Philadelphia)

Figure 47. A Run of Steel Bin Shelving (Multiple Unit) in the Large Stockroom of the Plant of John A. Roebling's Sons, Trenton, N. J. Note the heavy loads carried in the bins. Years of stability and service are built into this type of bin

actual storage space, is more flexible, fireproof, cleaner and lasts longer. The storage of materials in movable containers, such as totepans and dolly boxes and placing piled material on skids so that lift trucks may be used avoids much unnecessary handling.

So that materials may be rapidly and easily handled and all available storage space utilized it is frequently desirable to invest in

suitable auxiliary storeroom equipment. One concern found that the use of a tiering device, similar to the one illustrated in Figure 6, permitted them to gain approximately 40% in storage capacity and that two men were able to do the work in place of five men that formerly had been required. Similar instances have been found in numerous plants having heavy or bulky materials to store. Where materials

(Courtesy of David Lupton's Sons Co., Philadelphia)

Figure 48. A Run of Steel Bin Type Counter Just Inside a Run of Steel Partition. Daily needs are handily stored in this counter and quick service is assured because of the accessibility. This installation is in the plant of John A. Roebling's Sons Co., Trenton, N. J.

are of varied type and are comparatively light and small the full height of the storeroom can be utilized if ladders are used or if a "set back" arrangement is followed in building the shelves,—that is, the second tier of shelves is made a foot less in depth leaving the top of the first tier as a platform to stand on in reaching the upper shelves. (See Figure 47.) Both arrangements are used but, in general, ladders on trolleys are preferred.

Good luck Charlie

Other auxiliary equipment frequently found desirable are "one-man" hand trucks to save labor in moving materials, counting scales and other mechanical methods for weighing, measuring and counting, and cutting off tools such as power hack-saws. The equipment needed will naturally vary with the kind and volume of material handled and the conditions under which work is done.

The Storeskeeper.—The type of man to be selected as storeskeeper depends upon the kind, volume and value of the materials stored and the extent of his responsibility. If the materials are bulky and of but nominal value and are stored out in the yard or in an open shed accessible to any passing workman the storeskeeper cannot justly be held responsible for them, and the type of man to be selected is probably one who is capable at handling materials. In the average plant of fair size stores ordinarily consist of quite a variety of materials, many of them of considerable value. This necessitates a different type of storeskeeper. In the past the storeskeeper was usually one of the older shop men who had always been a conscientious and capable worker but had grown past the age of full working capacity at his old job. As the management did not wish to dismiss a faithful employee they gave him the job of storeskeeper in lieu of a pension. They felt he knew materials from his years of work with them and so was competent to care for them. As a general rule such a man is not competent to keep the necessary records of receipts, issues and stock on hand. The actual handling of materials, the physical work of receiving, storing and issuing them, is only a part of storeskeeping. A certain amount of clerical work is involved and the average shop man is not fitted for and, in the great majority of cases has a strong dislike for such work.

The man to be selected as storeskeeper and held responsible for the accounting for, safekeeping, and issuance of materials should be a capable and conscientious person, one who is familiar with materials and will appreciate their value and be fully alive to his responsibility in caring for his company's property. He should have a strong sense of order abhorring disorder in the storeroom and insisting upon perfect records. He should be rather exacting, permitting of not the slightest infraction of rules on the part of his assistants or of the shop men in their relation to the storeroom. The storeskeeper who, when he is busy, will let a workman who is in a hurry

come and help himself may be considered a good fellow but he fails in his duty as storeskeeper. He is held responsible for the accounting for and safeguarding of all materials received and issued and he should keep the storeroom doors locked and allow no one to enter who has no business there. In this he should be pleasant but at all times firm, by his attitude winning the men to cooperation with him.

Necessary Steps in Material Control.—The following steps in the order given are essential to the adequate control of materials.

1. Purchase requisition made out by authorized person.
2. Purchase order written by purchasing department and copy sent to the comptroller's department, to the receiving room, and to the stock ledger clerk.
3. Materials received, checked against purchase order as to condition and quantity and inspected as to quality to see that they fully meet the specifications under which they were purchased. Defective material tags attached to such portions as do not pass inspection and reports sent to purchasing agent for adjustment.
4. Accepted materials sent to storeroom and there placed in proper location. Entries made on bin tag and on stock ledger.
5. Materials issued on authorized requisitions. Deductions made on bin tag and on stock ledger. Record of materials issued sent to cost division for purpose of cost allocation.
6. Materials received in storeroom from manufacturing orders (after processing and inspection).
7. Unused materials and materials received from other sources than through the purchasing department should be inspected, placed in proper location in storeroom, entries made on bin tag and on stock ledger and notice sent to the cost division so that proper entries may be made.
8. At intervals physical check of materials on hand against stores records.

Forms Required.—In developing a system of material control, unfortunately, the tendency is to devise an elaborate system requiring a lot of unnecessary forms. The result is that while the system looks perfect on paper, it involves too much "red tape" in practice, so

defeats its own purpose. The test of a system of material control is, first, does it do the work for which it was devised, and second, is it done in the simplest way and what is the cost of maintaining the system?

The simplest system with the least number of forms which will fit the particular needs is the system to adopt. The following forms are ordinarily required.

Purchase Requisition.—The purchase requisition is the form on which request is made for purchase of materials or supplies. (See Figure 40 in Chapter XV.) The purchase requisition should provide for definite instructions as to the kind, quality and quantity of material and the exact date required, the purpose for which the material is to be used, the point of delivery, the storeroom and location in the storeroom where it is to be stored, the person making the requisition, the symbol or part number and the date. Also it may be desirable to have a space for each person who must either approve the requisition or perform some duty in connection with it to sign his initials. "The purpose for which the material is to be used" is desirable to appear on the requisition in case there may be on hand an oversupply of an authorized substitute material which it is desired to use up, or an authorized substitute material which may be purchased at a saving in cost. The name of the person making out the requisition is desirable so that the purchasing department will know with whom to communicate if need be. The symbol or part number is for accuracy and to facilitate entry on the stock ledger and other forms.

Purchase Order.—(See Figure 45 in Chapter XV.) The purchase order form should provide for:

- Date of Issue.
- Order number with notation that this number is to be given on invoice.
- Name and address of vendor.
- Shipping instructions.
- Special markings to be put on shipment. Under "special markings" would come such other information as appears on the purchase requisition so as to facilitate handling and recording of the material when received.

Quantity, price, description and specifications of materials ordered.
Notice to acknowledge receipt and give probable date of shipment.
Terms on which order is placed.
Signature of purchasing agent.

Materials Received Report.—This form should provide for the vendor's name, purchase order number, part or symbol number, date of receipt, quantity and condition of goods received, whether prepaid or sent collect, cost of goods including all transportation charges and whether shipment completed the order. (See Figure 49.) The

RECEIVING SLIP Serial No. **1105**

Received from____________________ Date ________

Crates_____ Barrels_____ Boxes_____	Freight_____ Charges_____
Bundles_____ Packages_____ Pieces_____	Express_____ Charges_____
Purchase Order_____ Total Wgt._____	Traffic Page_____ Car No._____

Our Count	Our Weight	Their Count	Their Weight	Name or Description	Quantity Accepted

Received by Counted by Inspected by

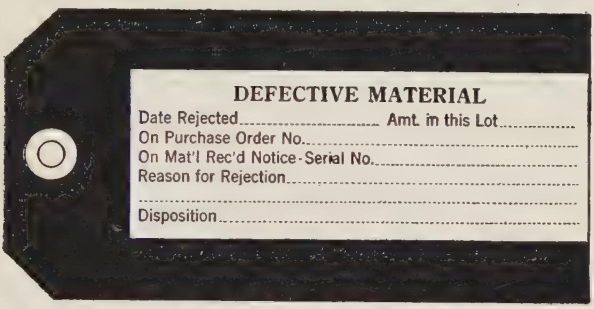
Figure 49. Receiving Slip

materials received should be checked against the receiving clerk's copy of the purchase order as to quantity, quality and agreement with all conditions specified on the purchase order and the copy returned to the purchasing department when the order is complete. In some concerns the quantities ordered and unit price and value are left off the receiving clerk's copy of the purchase order and the materials received report serves as a check that the goods have been actually counted instead of "guessed" at and marked that the correct amount was received. The method to be used depends upon local conditions.

Defective Material Tag.—When materials or supplies received do not pass inspection due to damage or not meeting specifications,

a defective material tag is attached so as to segregate them from materials that pass inspection. The purchasing department is then notified so that proper adjustment can be made with the vendor. (See Figure 50.)

Bin Tag.—A bin tag attached to the front of each bin serves to identify the contents of the bin. One of two ways is ordinarily



DEFECTIVE MATERIAL
Date Rejected.......................... Amt. in this Lot..............
On Purchase Order No...
On Mat'l Rec'd Notice-Serial No....................................
Reason for Rejection..
....
Disposition..

Figure 50. A Defective Material Tag. (The border and entire reverse side are colored red so as to be distinctive)

employed in the keeping of bin tags. In the older method a bin tag form is used on which, in appropriate spaces, are entered:

The date received.
Symbol or part number.
Name and description of the article.
Location in the storeroom.
Material receipts.
Amounts issued.
Date of issue.
The account to which issued materials should be charged.
Balance on hand.

Where the bin tag is filled with entries it is given to the clerk in charge of the stock ledger for checking with the quantity shown on his record. The new bin tag has noted on it the last balance shown on the old card. Some concerns make it a practice to have a physical count of all materials remaining in the bin at the time a new bin tag is made out. In the case of discrepancies the physical count number is entered on the old tag as well as on the new bin tag.

In a newer method which is apparently gaining in favor a bin tag is made out for each lot received. A bin tag is attached to each new lot in the receiving room as soon as the lot has been inspected and accepted. The fact that the bin tag is attached indicates to the truckers whose duty it is to transport material that the lot is ready to be taken

Symbol	Location	
Description		
Order No.		Unit
Quantity Received		Date
Date	Quantity and Balance	Order No.
(Over)		

(Courtesy of Winchester Repeating Arms Co., New Haven, Conn.)

Figure 51. Bin Tag (face of tag)

to the storeroom. The bin tag used is similar to yet more simple than the form used under the first method. Only three columns are needed—date of issue, quantity issued and balance, and charged to what account. No further receipts are entered on it after the first entry of the quantity received in the lot. Each new lot received has its own bin tag. All issues are made from the first lot received until

that lot is used up. Subsequent lots are always used in the order in which they are received. Each issue is recorded on the bin tag with its date, quantity issued and the account charged to. The amount issued is deducted from the balance shown on hand so that the final entry at any time shows the quantity of that lot remaining. When a lot is used up the bin tag has noted on it the total amount of materials shown on all other bin tags remaining in that bin and the closed-out bin tag is given to the clerk in charge of the stock ledger for checking with the quantity shown on the stock ledger. The main advantage given by those who advocate this method is that it gives a far more frequent check. Under the old method a bin tag representing material not so often used may not have sufficient entries to use it up in quite a long time.

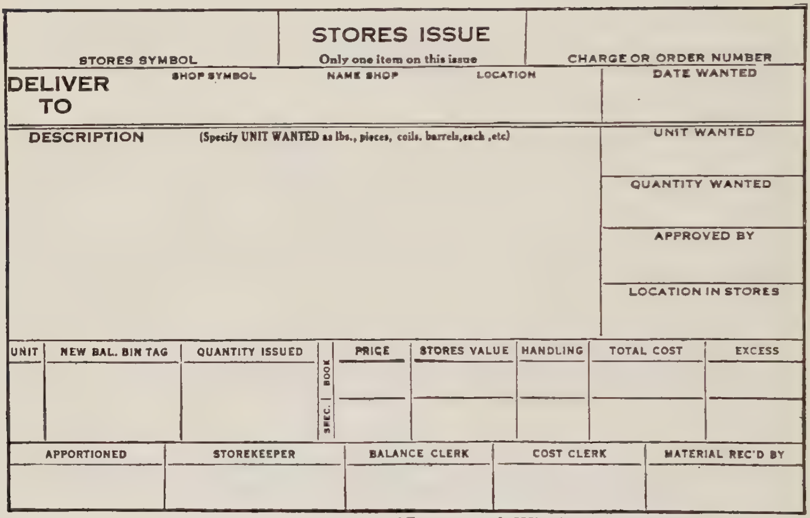
The bin tag is a simple form yet one which is easily maintained. It serves a number of purposes, among them are:

1. The final entry at any time upon the bin tag shows the quantity remaining in the lot or bin according to the method used.
2. The bin tag serves as a check on the stores record as the quantity noted on the bin tag should correspond with the balance on hand as shown on the stock record.
3. The storeskeeper in making an issue compares the symbol on the stores issue with the symbol on the bin tag. This serves to eliminate errors due to delivery of items other than those specified.

Figure 51 shows the front side of a bin tag such as could ordinarily be used. On the reverse side of the tag the three columns are continued and spaces are provided at the bottom for entering the total amount shown on tags remaining in the bin and for the signature of the storeskeeper.

Stores Issue.—Materials are disbursed from stores only upon an authorized requisition. The form used is ordinarily called a stores issue or stores requisition. The requisition may originate with the foreman who wants the material to use on a production job or it may be made out by the planning section as is done in those concerns which have adopted a system of production control. Ordinarily one item is asked for on a stores issue slip, when two items are required

two slips are used. When a number of different items are required as, for example, the parts entering into an assembly, a group stores issue form is employed to simplify the clerical work and to facilitate issuance of materials. Figures 52 and 53 illustrate stores issue forms. Both forms shown are merely suggestive. Changes in the form and in the information to be covered would probably have to be made to meet the needs peculiar to some other plant. This same thing holds true in regard to the great majority of forms. There is no one


STORES SYMBOL
STORES ISSUE
Only one item on this issue
CHARGE OR ORDER NUMBER
DELIVER TO
SHOP SYMBOL
NAME SHOP
LOCATION
DATE WANTED
DESCRIPTION (Specify UNIT WANTED as lbs., pieces, coils, barrels, each, etc)
UNIT WANTED
QUANTITY WANTED
APPROVED BY
LOCATION IN STORES
UNIT
NEW BAL. BIN TAG
QUANTITY ISSUED
BOOK
SPEC.
PRICE
STORES VALUE
HANDLING
TOTAL COST
EXCESS
APPORTIONED
STOREKEEPER
BALANCE CLERK
COST CLERK
MATERIAL REC'D BY

(Courtesy of Winchester Repeating Arms Co.)

Figure 52. Single Stores Issue Form

perfect form for any purpose to be followed in all cases. A form that is perfectly satisfactory in one plant may be quite unsuitable in another. The forms given in the text are simply some that have proved satisfactory in some plants and can therefore be used as a guide in planning for another plant by adapting the form to meet the needs and conditions of work found there.

The stores issue form should provide for the following information:

Date and number of requisition.
Description of material and part number or symbol.
The storeroom and the location in stores.

STORES SYMBOL	GROUP STORES ISSUE This form shall only be used for materials issued from the same control				CHARGE OR ORDER NUMBER
SHOP SYMBOL	NAME	LOCATION	DATE WRITTEN	DATE WANTED	APPROVED BY
DELIVER TO					

DESCRIPTION	UNIT	QUANTITY WANTED	NEW BAL. BIN TAG	QUANTITY ISSUED	UNIT PRICE	VALUE	SPECIF. COST	EXCESS COST.

ISSUING STOREKEEPER		BALANCE SHEET		MATERIAL RECEIVED BY		TOTALS		
DATE	BY	DATE	BY	DATE	BY			

Figure 53. Group Stores Issue Form

(Courtesy of Winchester Repeating Arms Co.)

The production order number or the account number to which materials are to be charged.

Quantity desired given in appropriate units such as pound or other unit of measure.

Unit cost and total value of materials requisitioned.

The date and time delivery is to be made. The exact location or the name of the first operation in the shop to which the material is to be delivered should be given. In some concerns the section or shop making the requisition sends one of its own men to the storeroom to call for the material. In many of the larger concerns working under a system of production control the material control section is responsible for the delivery of the material to the machine or workplace where it is needed.

Signature of the person or persons authorizing the requisition and receiving the material.

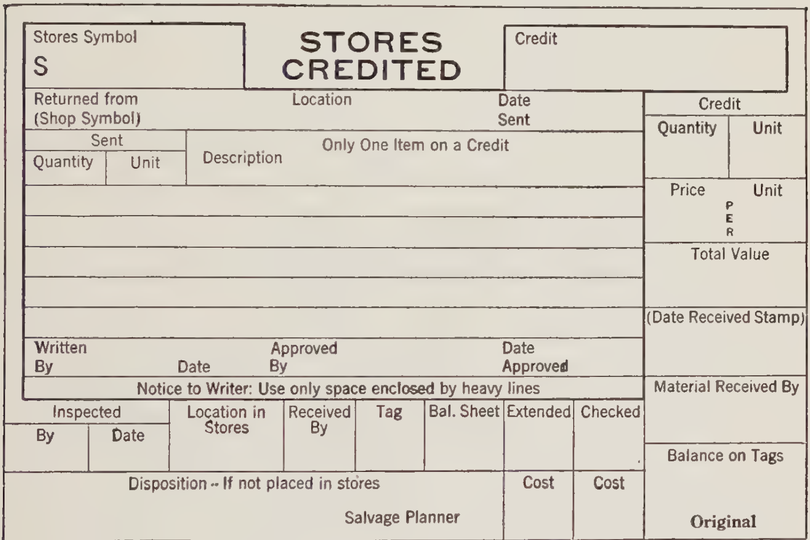
Signature of the storeskeeper.

With some forms spaces are also provided in which persons performing certain duties in connection with the issuance of stores will write the date and their initials. These duties may include the making of reservation on the stock ledger, the moving of material, the making of entries on progress sheets, etc.

Stores Credit.—When unused materials are returned to the storeroom they should be accompanied by a stores credit slip. If the materials after inspection are found to be in the same condition as when they were issued the account that was charged for the materials is now credited for the amount returned, care being taken that the cost per unit credited is the same as that charged when the goods were issued. The form used covers in general the same information as that given on the stores issue form except that the word "credit" is used instead of "charge" on the stores credit slip. The reason for the material being placed in stores should always appear on the form. A copy of the stores credit slip is given to the clerk in charge of the stock ledger for notation on the stock record and to the accounting department for its information for cost records. Figure 54 shows a stores credit ticket.

The use of the stores credit slip should be restricted to the return of excess materials that were unexpectedly left over on a production

order and to those cases where material for one cause or another must be diverted from one order to another order after being charged to the first order. In this latter case a stores issue slip must also be used following the usual routine. The bad practice of some foremen of withdrawing more material than is required for an order with the expectation of returning any that is unused should be guarded against. It is a dangerous practice for if every foreman followed such a practice inventories would greatly increase, there would be more spoilage and breakage and the control of materials would be


Stores Symbol
S
STORES CREDITED
Credit
Returned from (Shop Symbol)
Location
Date Sent
Credit
Quantity
Unit
Sent
Quantity
Unit
Description
Only One Item on a Credit
Price
PER
Unit
Total Value
(Date Received Stamp)
Written By
Date
Approved By
Date Approved
Notice to Writer: Use only space enclosed by heavy lines
Material Received By
Inspected
By
Date
Location in Stores
Received By
Tag
Bal. Sheet
Extended
Checked
Balance on Tags
Disposition -- If not placed in stores
Salvage Planner
Cost
Cost
Original

(Courtesy of Winchester Repeating Arms Co.)

Figure 54. Stores Credit Form

broken down. The old theory of having extra materials so "in case I should need them" has been proven a very wasteful and inefficient one. Under an adequate system of material control materials are disbursed in the exact quantities needed.

If some of the materials have been spoiled and are returned as scrap, credit is given for the scrap but on a different form than a "stores credit" given for materials returned in the same condition as issued. The value of the materials as scrap is credited to the account originally charged for the materials.

Material Received from Manufacturing Orders.—In order to place materials from a manufacturing order in stores a form similar to the one shown in Figure 55 is used. The headings shown are self-explanatory. The use of this form as well as all other material control forms will be explained in detail later in the chapters on production control.

STORES SYMBOL

STORES
MATERIAL RECEIVED
FROM MANUFACTURING ORDERS
COPY 1

ORDER NO.

QUANTITY CALLED FOR ON ORDER 1	QUANTITY PREVIOUSLY SENT 2	QUANTITY SENT HEREWITH 3	TOTAL QUANTITY SENT TO DATE (INCLUDING 3) 4	UNIT	SERIAL NO.	ACCEPTED QUANTITY	UNIT

DESCRIPTION

PRICE PER UNIT

TOTAL VALUE

SENT FROM TO STOREROOM

WRITTEN BY DATE APPROVED BY DATE APPROVED

DATE REC'D (STAMP)

NOTICE TO WRITER: USE ONLY SPACE BETWEEN HEAVY LINES

INSPECTED DATE	BY	LOCATION	RECEIVED BY	TAG MADE OUT BY	ADDED TO BAL. SHEET	COST MADE UP BY	COST CHECKED BY	BALANCE ON TAGS

ALL MATERIAL (FROM MANUFACTURING ORDERS) MUST BE DELIVERED TO THE STOREROOM ACCOMPANIED BY THIS FORM

COST ENTERED ON COST SHEET	COST DIV.	COST ENTERED ON BAL. SHEET	DOES THIS COMPLETE THE ORDER? YES / NO	SIGNED BY MAN DECIDING

STORES MATERIAL RECEIVED FROM MANUFACTURING ORDERS.

(Courtesy of Winchester Repeating Arms Co.)

Figure 55. Material Received from Manufacturing Orders Form

The Stock Record.—The stock record, sometimes spoken of as the perpetual inventory form or the balance of stores record is an essential part of material control. It is a record of each item of material used in the plant, and contains all the information desired as to quantity of material ordered and received, the quantities issued, the balance on hand and the factory requirements for that item. It shows at all times the quantity on hand in the storeroom, the quantity on order but not delivered, the quantity that has been reserved for the filling of manufacturing orders but has not yet been issued from the storeroom and the quantity actually available for future use.

The stock record is also a check on the operation of the store-

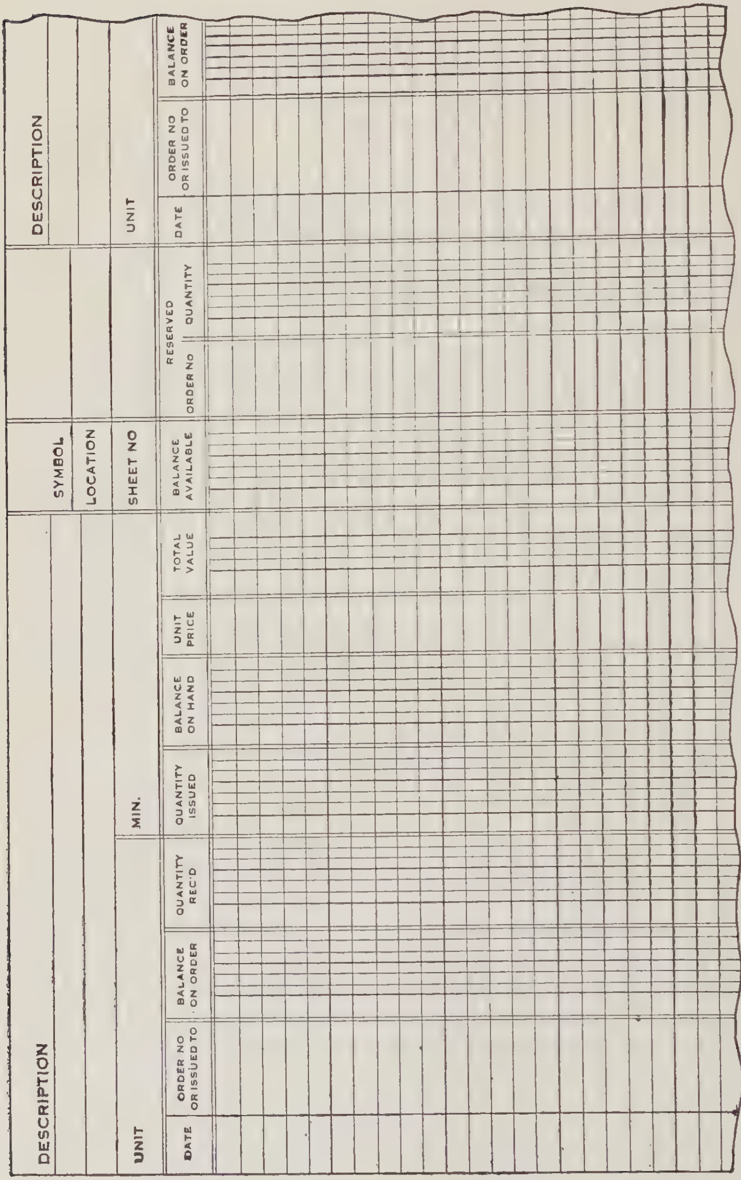
room, hence, if possible, it should be kept in the material control office apart from the storeroom.

The value of the stock record as an aid in the proper control of a plant can hardly be overestimated. One of the chief advantages is that with all conditions of stores definitely known orders do not go into production until all of the materials required are on hand or at least there is definite assurance that they will be on hand and available when needed. Thus it permits the planning of production on a definite schedule to meet the sales requirements. Likewise it permits the accounting division accurately to allocate costs of materials to shops or sections and to orders and to prepare periodical statements of profit and loss and balance sheets without a physical inventory. For the purchasing department it serves to guard against the procurement of an excessive supply of any item, thus balancing stores with production requirements and avoiding tying up unnecessary capital in materials and supplies. It is the record of plant consumption of any item and study of it frequently permits the purchasing executive to take advantage of a favorable market through knowing rather definitely future requirements. Thus the stores record is an aid in more than the control of stores. It is also invaluable for adjusting losses in the case of fire. In stores control it aids in pointing out the orders to be filled and the exact quantities covered, but its full purpose is broader than that for it aids in the control of costs, of purchasing and of production itself.

Stores records are ordinarily kept in one of two ways:

1. Loose-leaf books of the ledger type.
2. Card files.

Both cards and sheets have their advantages and both are widely used. Cards are objected to by some who maintain that they are too easy to put into one's pocket or stick up behind the telephone and leave there. Others are equally insistent that cards are preferable. In smaller concerns where a simple system of stock control is all that is required the card has decided advantages as a file of cards is very readily cared for and it is a simple matter to make the necessary notations. For concerns with a more extensive system the loose sheets are to be preferred for they permit of the entry of more data. Entries are often made by hand with pen and ink. The use of bookkeeping machines, however, has lately been extended to the keeping



(Courtesy of Winchester Repeating Arms Co.)

Figure 56. Stock Ledger Form

of stores records effecting a considerable decrease in labor and increase in speed.

Figure 56 shows a suggested form of stock record. Most of the headings are self-explanatory. The following briefly describes headings which might need explanation.

1. *Maximum and minimum.* Maximum and minimum are standards set to prevent over or under buying, the object being always to have on hand sufficient materials to take care of production needs thus preventing delays due to lack of materials and yet not tie up an undue amount of capital in inventories. The determining factors in setting maximum and minimum standards are the production requirements in the particular item and the time required to obtain a new supply. The available storage space, the financial condition of the company, the general market conditions and the quantity at which the most advantageous price and terms can be secured all are influencing factors.

2. *Reserved.* Where there is a steady flow of work with little or no change in the production schedule there will be no need of allotting certain materials in advance to a particular production order. However, when production requirements fluctuate, and the fluctuations are known, it is customary to assign to a manufacturing order its material requirements, for if this is not done an order might go into production when the balance on hand was considerably above the minimum and yet consume the entire stock on hand, or at least use sufficient of it that production on other orders would have to be held up until a new supply could be obtained.

3. *Balance available.* The reserved column allows for assigning materials in advance to definite manufacturing orders. The balance available column shows the balance which is available after such appropriations have been deducted from the balance then on hand. This is a truer picture than the balance of goods actually on hand can give. By comparing the last entry in the balance available column with the minimum there can be no danger of failing to place a purchase order in time.

Physical Inventory.—Even when a perpetual inventory is maintained a physical inventory should be taken from time to time to check the stores record. There are a variety of ways of taking physical inventory. The following are among the more common:

1. *Each day the storeskeeper checks the actual balance on hand of a few items against the balance as shown on the bin tag.* He then records the quantities as found on an inventory tag which is sent to the clerk in charge of the stock record for verification with the balance as shown on the stock record. The number of times a year the balance of an item is checked depends on the importance of that item.

2. *Whenever a requisition for purchase of a new supply of an item is made, the actual balance is checked against the bin tag and the perpetual inventory.* This method has the advantage of having the count taken when the material on hand is at the lowest point and is a method frequently employed.

3. *Physical count at the close of the year or semiannually.* Under this plan inventory time is the dread of the year. Inventory taking is something to be gotten over as quickly as possible, hence often there are inaccuracies and unsatisfactory results in general. It is frequently necessary to close the plant for the length of time required to count and check materials and stocks on hand. This disorganizes the plant and when work is commenced again it is hard to pick up threads where they were left off. In addition errors accumulate in the period between physical count and check and discrepancies sometimes are not found until several months after they occur. For these reasons this method is not generally employed although in former years before perpetual inventories were adopted it was the method commonly used.

The following method of the Union Special Machine Company of Chicago, as quoted in the Perpetual Inventory and Stores Control Bulletin of the Department of Manufacture, Chamber of Commerce of the United States, illustrates a plan which is well worthy of consideration.

1. We accept our ledger accounts as of December 31 in any year as correct and as our inventory as of December 31; therefore no inventory is taken at that time.

2. In order that we may know that the ledger accounts and therefore our inventory is correct, the following procedure is employed during the year:

(a) Each month throughout the year a portion of our bins is checked against the corresponding inventory cards for overages, shortages, obsolescence, overstocks and over or undervaluations. Any discrepancies are corrected by correcting entries to both inventory cards and ledger control

accounts. These entries are made on the date the discrepancy is discovered. This checking is done at a rate which insures that every card is checked at least once in each year.

(b) Each month sections of the inventory cards included in one ledger control are totaled and correcting entries made to the control for the difference, if any, between the sum of the inventory cards and the ledger control. This totaling is done at a rate to insure that all sections are totaled at least once in each year, in addition to totaling described under (c).

(c) Starting November 1, all sections of the inventory cards are totaled against the control, in the month of November and correcting entries made to the control for any differences between total of cards and ledger control of cards.

(d) An auditing section reporting directly to the general manager assumes the responsibility of spotchecking and notifying the general manager if inventories are not correct.

This procedure has the following advantages:

1. Our balance sheet is correct every month in respect to values of inventories instead of only being correct at the end of the year. As we issue a monthly balance sheet and income statement, this is of importance.

2. There is no delay in closing books at the end of the year due to inventories.

3. There is a correct valuation of inventories since we found it practically impossible to take a correct inventory at the end of the year. It appears to take continuous work during the year to get correct inventories.

4. There is an absence of large correcting entries in the month of December.

5. We avoid misstatements of profits during the year, due to over or undervaluation of inventories.

CHAPTER XVII

MANUFACTURING DEPARTMENT

Scope and Importance.—The manufacturing department is responsible for turning out the product. When the factory is a small one-man concern the man in charge determines the method of making the product and the tools and materials to use. He knows everything that is going on and he sees to it that the work is done according to his directions. When the factory emerges from the "one-man" stage the work is divided. The engineering department designs the product and prepares the drawings and specifications of what to manufacture and other data needed in planning production. The purchasing department purchases the materals specified by the engineering department and sees to it that they are on hand when needed. It is then up to the manufacturing department to take the materials purchased and the data furnished by the engineering department and by the proper use of labor, machinery and equipment transform the materials into a finished product as per specifications set.

In performing its function the manufacturing department is confronted with more and a greater variety of problems than any other department. The product turned out must meet the demands of the market from the standpoint of quality, quantity and rate of delivery as shown by the requirements of the sales department, yet costs must be held down to a minimum. Quantity production should be striven for as low production means increased costs, yet quality of product must not be sacrificed for quantity. The demands of the sales department for rush deliveries and for changes in design to meet the needs of important customers should be met wherever possible, yet not at the price of unwarranted increase in costs or interference with regular production. High wages must be paid in order to hold competent workers, yet labor costs must be kept low to insure fair profits to the owners. This can only be accomplished through detail study of each operation and careful planning of proper methods, then standardization and the fixing of a fair rate of compensation with reward commensurate to the skill required and to effort expended. In as-

sembly industries where parts are made or worked on in various shops such as the forge shop, machine shop, paint shop, etc., production in the various shops must be carried on in proper relationship to that of the other shops and timed so that the output of each shop will be of such parts and in such quantities as are needed for the completion of the required assemblies so as to fill the sales orders and make shipment of them by the dates specified. The above gives but a small conception of the importance of the manufacturing department and of the varied problems which must be solved satisfactorily if it is properly to perform its function. Planning for production is essential in modern manufacture. This fact is no longer questioned. As to how far planning should be carried depends upon local conditions. In this and the next several chapters methods of planning and smoothing the way for actual production are discussed. These, if adapted to conform with local requirements, can then be applied advantageously in the individual cases.

Organization of the Manufacturing Department.—Figure 57 gives an organization chart of a typical manufacturing department showing how the work of the department can be broken down logically into the necessary subdivisions.[1]

At the head of the manufacturing department is the director of manufacturing, or factory manager as he is frequently called. The title given varies in practice. Regardless of his title, the man in charge of the department has control over all matters pertaining to the manufacture of the product and to the actual operation of the plant. In many respects the welfare of the company hinges upon the degree of success with which he fulfills the duties of his office. It is his responsibility to see that the manufacturing department performs its job; that is, that it manufactures the product according to the plans laid down for it at the least possible cost, all influencing factors being considered and that it cooperates intelligently and wholeheartedly with the sales department and all other related departments and with the company as a whole. This is a man-sized job. It requires an alert, energetic leader—one who knows everything that goes on in his plant—one who can be relied upon to "keep his head" and to handle wisely and efficiently the many and varied problems

[1] Frequently the Production Engineering Division is known as the Production Division and the man in charge the Production Manager. In many industrial concerns purchasing is included as a part of the work of the manufacturing department and a separate division set up for it as shown in the chart in Figure 25.

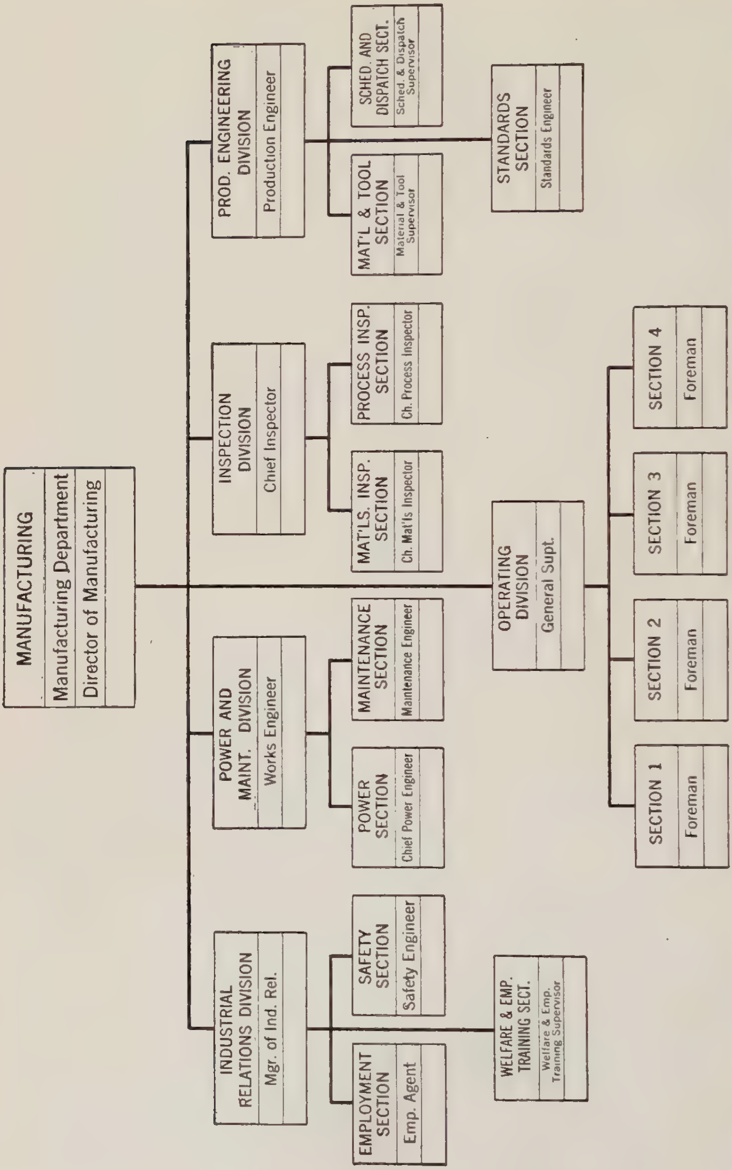


Figure 57. Organization of Manufacturing Department. Frequently the Production Engineering Division is known as the Production Division and the man in charge the Production Manager. In many industrial concerns purchasing is included as a part of the manufacturing department and a separate division set up for it as shown in the chart in Figure 26

which come up almost daily to the average plant. He must have the ability to direct and control men of different lines of work and of different temperaments and to develop teamwork among them. The problems arising in the control of a plant are varied, the man in charge must be broad in proportion. He must be a good judge of men so that he can be depended upon to select competent men to associate with him. He must be able to recognize the working limits of his subordinates, not overload them but give them sufficient responsibility and opportunity to show their ability and initiative so as to develop them wisely. It is his duty to see that the work gets done. To accomplish this he must maintain at all times the highest practical degree of efficiency in his department, yet he must control with a minimum of direction, giving only such orders as can be reasonably carried out and then seeing that these orders are enforced to the letter.

As shown in Figure 57 the work of the department is broken down according to the functions covered and a properly qualified man is placed in charge of each division. Each division head has the necessary authority delegated to him to carry out the work of his division and he is then held directly responsible for results. The work of each division is similarly divided and authority and responsibility delegated to those placed in charge. Thus the actual work of making the product is taken care of by the operating division the work of which is divided and authority and responsibility delegated to those placed in charge, namely, the foremen. This is an excellent example of delegation of authority and responsibility which comes in a direct line from the general manager to the foremen who are in direct charge of the workers. This method of organizing not only distributes the executive burden but serves to build up a strong organization by developing all subordinates through giving them the necessary authority for carrying out certain phases of the work and then holding them directly responsible for the results attained.

The other divisions shown on the chart in Figure 57, namely, industrial relations division, inspection division, power and maintenance division, and production engineering division, are service or staff divisions the function of which is to assist or support the operating division, each working in its own specified field and doing its part in relieving the operating division and so leaving it free to devote all of its time and efforts to its particular function, namely the actual

making of the product. In the remainder of the chapter the work of each division of the manufacturing department will be considered briefly so that the reader may gain a conception of the work of the department as a whole and of the interrelationship of the work of the several divisions. The work of each division will be discussed in more detail in subsequent chapters.

Industrial Relations Division.—The function of the industrial relations division is to supply the man power and to maintain proper and fair relations between the company and its employees. This serves to relieve the operating division of the task of finding suitable men, thus lifting a big burden from the shoulders of the operating supervisors. In addition it eliminates those fertile sources of friction that are found almost universally, at least to some extent, in plants where the supervisors select the workers in their charge. We are all familiar with the foreman who is just a little vain of his position as "Boss." If he has the authority to hire and fire he is very likely, at some time or other, to act like the foreman in that old story with which we are all familiar. When asked if he were boss of a certain job he answered, "Sure, I am, and I can prove it. Mike! You're fired." This pride in being a "Boss" and desire to show authority or the fact that the boss is out of sorts or hot-headed has been the cause of many an unfortunate worker's unjustly losing a much needed job, and the company's losing a valuable trained worker. Hiring and firing being placed in the hands of an employment section removes all opportunities for such unfairness. In addition it materially raises the standard of the working force.

The average foreman has not the time to seek out sources of labor supply so is very likely to take those who come to him or to favor his friends or men recommended by his friends. Selection of workers should be in the hands of men who know where to look for competent workers when they are required and who are competent to judge as to the fitness of an applicant for a particular job. Furthermore those in the industrial relations division are removed from direct supervision and everyday contact with the workers so can view the human relations impartially and not as a man closely connected with active production might possibly do. In case of dispute they are more apt to see both sides of the question, personalities do not enter into it and the decision as to what is best to do is likely to be fairer to all

parties concerned. Thus the morale of the workers is raised as they feel the industrial relations division is their court of justice where they can always expect to have their side of a question heard and fair treatment accorded. If the head of the industrial relations division fully appreciates the importance of his position and merits the confidence placed in him he can make the work of his division invaluable in keeping down labor troubles, reducing labor turnover and in general greatly facilitating the operation of the plant through maintaining at all times a contented, competent working force.

The employment section of the industrial relations division shown on the chart in Figure 57 is responsible for the procurement of competent workers. The safety section has charge of all safety work. The welfare and employee training section is responsible for the training of employees, working conditions, and any welfare work done by the company in the interest of its employees.

Power and Maintenance Division.—The functions of the power and maintenance division are to provide such services as are assigned to it and to maintain the machinery, equipment, buildings and grounds in such condition as will permit the plant to be operated at the highest practical point of efficiency.

In those plants where responsibility for maintenance is divided, due to neglect, a machine may break down the output of which is necessary for the operation of other operating units. Such a breakdown entails not only loss due to idle machine time, lost time on the part of the operator, cost of repair parts and labor or replacement, but of far greater importance, loss due to interrupted production. The loss involved in the latter may be several times the value of the machine itself. When responsibility for caring for the maintenance function is centralized and proper records kept it is known which parts of the machinery and equipment are most subject to wear or breakage. It is then the duty of the head of the maintenance section to see that such machinery and equipment are inspected at frequent regular intervals and that proper adjustments and repairs are made. Likewise it is his duty to see that the necessary repair parts and tools to use in making repairs are kept in stock so that repairs can be made with a minimum of lost time. He must see that the floors are kept clean and repaired when necessary and that the plant in general presents a good appearance and is in a sanitary condition. A

plant has been aptly compared to a large machine to be kept at all times in an efficient operating condition at the least possible expense.

The power section is responsible for keeping a constant and adequate supply of steam, electricity, gas, compressed air, water, etc., as may be required. From even the above brief outline of the function of the power and maintenance division it is at once apparent how important the work of the division is and the part it plays in supporting and smoothing the way for the operating division.

Inspection Division.—The vital importance of maintaining a set standard of quality cannot be overestimated. It is the function of the inspection division to safeguard the quality of the product by the inspection of all materials and parts purchased, to see that they are up to the standard of that which was ordered and by the inspection of all work in process to see that the required accuracy of all operations is maintained.

The extent to which inspection should be carried depends upon the product and local conditions. Inspection should be carried only so far as it is necessary; that is, to the point of maximum profitable returns.

Inspection should not be considered in the light of "faultfinding," but rather of safeguarding. By analyzing the causes of rejection and making recommendations to the proper person the inspection division can prove an invaluable aid in removing or counteracting these causes. A more thorough discussion of the work of the inspection division is covered in Chapter XXII.

Production Engineering Division.—Planning is done, at least to some extent, in every industrial plant regardless of its size or the type of product made. The superintendent may plan the sequence of orders to be filled, marking the jobs to be done in the order in which the orders have been received perhaps giving preference to the orders of those customers demanding prompt shipment. He may then leave the job entirely up to the foreman, depending upon him to get the work out. Centralized planning for production by a production engineering division established for that purpose is simply reducing once more the number of functions the foreman must perform by placing that function in the charge of experts or specialists in that field of work. It is another application of that principle of specialization which has played such an important part in the develop-

ment of modern industry. As Frederick W. Taylor so clearly put it, "Establishing a planning department merely concentrates the planning and much other brain work in a few men especially fitted for their task and trained in their especial lines, instead of having it done, as heretofore, in most cases by high-priced mechanics, well fitted to work at their trades, but poorly trained for work more or less clerical in its nature."[2] Frequently this division is known as the Production Division, and the man in charge the Production Manager.

It is possible to plan every step in the control of production in every plant. In many cases, however, it would not be desirable as such planning would cost more than it would save. The extent to which planning should be carried in any particular case can be determined only after a careful analysis of the individual concern in question. In some concerns the extent of planning should be confined to the preliminary planning done by the engineering department which clears the way, so to speak, and puts things in general readiness. In other plants, especially in those where products, with possibly only slight changes, are manufactured in large quantities, planning can be carried to great refinement. The majority of concerns fall somewhere between these two extremes. Broadly, the functions of the production engineering division could be listed as follows:

1. To have charge of the analyses of operations and all time study work, standardization, standard routings, methods, investigations and estimating. To have charge of engineering changes, engineering releases, blueprint distribution, and so on.

2. The second group of activities includes charge of the various storerooms (raw material, work in process, and finished parts), of material issues, and responsibility for keeping accurate balance of stores records and for the issuance of purchase requisitions. Shop transportation, a factor of vital importance in large-scale production works, is a part of this division's responsibility. Along with this group of activities would be included the design, manufacture[3] and maintenance of tools, jigs, fixtures, dies, and gages, as well as charge of the tool storeroom and tool cribs.

3. Scheduling, dispatching, issuance of work orders, move tickets, etc., and the keeping of production records.

It is apparent that the production engineering division, in so far

[2] Frederick W. Taylor, Shop Management, p. 66. Harper and Brothers.

[3] Frequently certain tools, jigs, fixtures, dies, and gages can be more profitably purchased from concerns specializing in the manufacture of such products.

as is possible, provides a steady flow of work along the line so as to secure uninterrupted operation on the part of machines, processes and workers, hence completes smoothing the way for production.

Operating Division.—The actual making or fabrication of the product is done in the operating division, more familiarly spoken of by the layman as the "shops." The operating division is organized or divided into as many sectional units or so-called shops as the manufacturing work demands. Thus there may be a forge shop, a machine shop, a paint shop, an assembly room, and so on. In organizing the operating division consideration must be given to the requirements necessary for delegating authority and responsibility and for keeping accurate manufacturing costs. In order to have responsibility centralized for the control and operation of automatic screw machines there may have to be set up a separate section for automatic screw machine work in the charge of a foreman who is an expert in handling such machinery. To permit of keeping accurate manufacturing costs similar provisions may have to be made. For example, all shops carry overhead. Overhead usually is different for different kinds of work. In a forge shop it is high compared with that in an ordinary machine shop and the latter is high, in turn, compared with that in an assembly room where no machinery or power may be required.

The head of the operating division is the superintendent, who, in turn, delegates authority to the foreman, a foreman being in charge of and responsible for the work of a shop or sectional unit.

Cooperation of the Divisions.—With the industrial relations division supplying the workers and devoting itself to the task of ironing out all causes of friction between the company and its workers and thus endeavoring to maintain a contented working force; with the power and maintenance division providing power, light, heat and other necessary services and maintaining the buildings, grounds, machinery and equipment in good working condition; with the inspection division safeguarding the quality of the finished product by inspection of raw materials to see that they are up to specification and of work in process and of the finished product to see that it is up to the standard set; with the production engineering division planning the flow of production through the plant from raw materials to finished product, insuring correct assignment of work to each

operating facility and supplying the proper tools and materials for the workers to work with, it would seem as if the making of the product were a very simple matter and that the operating division was in the enviable position of having the greater and harder part of its work done for it. That would be an ideal condition indeed but few if any industrial plants even approach the ideal in this respect. Work never flows exactly as it has been planned. It is one thing to plan and issue orders; it is quite another thing to carry them out.

In every plant there are bound to be breakdowns, men absent or quitting, jams and a thousand and one other difficulties coming up every day. It is up to the superintendent and the foreman of the shop in which the trouble occurs to find out the trouble and rectify it so as not to hold up production and disrupt the production schedule and run up costs. It is the function of the operating division to make the product. It is the duty of the superintendent to get the work out. In this he must rely upon his foremen. They must be alert and resourceful. The flow of work is planned by the production engineering division but the foremen, because of their experience, can often give suggestions as to means of making the flow more smooth or more rapid. Likewise with inspection. It is the function of the inspection division to safeguard the quality of the product by inspection of work in process. The true foreman, however, does not leave inspection solely to the inspectors. He wants to maintain a high standard of quality, to increase production and to keep scrap down to a minimum in his shop. He, therefore, does not wait for the inspectors to report trouble to him. He is on the alert for any operation where trouble or error is likely to occur. He inspects the first few pieces from a machine after a new set-up. He knows when things are not going right. When a workman is careless or is not performing an operation according to directions the foreman who is "on the job" knows that fact. He soon discovers the reason why and the worker either does his work as he should do it or he is replaced by one who will.

Foremen are rightfully called the "key men" of industry. The job of foreman is of vital importance. The best of plans of the industrial relations division may be nullified by a surly, overbearing foreman. A plant with but a meager industrial relations program may have a loyal working force through its fortunate selection of able foremen who are true leaders of their men. While the foreman

in modern industry has been relieved of many duties formerly cared for by the old-time foreman he still shares responsibility with the specialists in charge and is himself responsible for the big task of getting the work done, keeping down costs due to scrap and other losses in materials, tools and time and building up and maintaining the loyalty and morale of his men.

CHAPTER XVIII

INDUSTRIAL RELATIONS DIVISION

Industrial Relations Function: Its Scope and Importance.—The industrial relations division has charge of that function which has to do with the relationships between employer and employees. The object of industrial relations work is to build up and maintain a stable, loyal and efficient working force, without which no concern can hope to progress very far. Within the scope of the work of the industrial relations division is included the employment and training of workers, placing each worker where he is best fitted to serve himself and his company, the betterment of working conditions both in regard to the safety and to the comfort and general well-being of the workers and any welfare work conducted by the company in the interests of its employees.

The extent to which industrial relations work is carried in practice differs widely even among representative concerns. A personnel program to fit the need of an individual concern can only be determined after a thoughtful, conscientious study of the particular conditions surrounding that concern. No personnel program will succeed unless based upon such a study and promoted with the interest of all—employer and employees—in mind. When in times of abundance of available labor the management of a concern ignores labor, treating it as a commodity that should be bought at the lowest possible figure, it cannot expect its acts to be accepted in good faith by the workers if, in times of shortage of labor, it suddenly changes its tactics and tries to hold its present workers and to attract additional ones by introducing a lot of so-called welfare work.

A personnel program, no matter how extensive and no matter at what cost it is put in operation, will fail if the management does not hold the confidence of its workers. Management must build up confidence by giving the workers justice. The worker asks opportunity to earn wages adequate to the necessities of life and a reasonable amount of comfort. He wants to be able to have a feeling of per-

manency in his job, an opportunity to win advancement, and the assurance of fair treatment at all times. He wants to feel he is a part of the organization and has a voice in those matters that very closely concern him. A company that sincerely cooperates with its workers wins their confidence, earns a reputation for fair dealings and reaps direct returns in times of general labor shortage. It is when this confidence is lacking due to past treatment that the agitator finds a fertile field. When trouble is brewing, it is then too late to build confidence. The agitator appeals to the emotions of his audience, he defiantly asserts their rights and stresses eloquently the wrongs that are being done to them. Under such conditions, workers will not listen to the promises of management, for due to their past experience they feel and, perhaps rightly, that the promises will be only half-heartedly carried out, or perhaps broken when the labor shortage and conflict are over.

Many a concern, forced by economic conditions due to the World War to drop their driving methods, went to great trouble and expense and inaugurated extensive personnel programs to conciliate labor. Such a procedure is not building confidence, it is merely taking care of an emergency with the best tools at hand. Personnel work, to be lasting, must be done from a long-range viewpoint. It must be in a sincere endeavor to cooperate with labor, to have the workers feel they belong, that they are a vital part of the organization. That is the only worth while industrial relations work. As to how to go about such work depends upon the needs of the particular company and the conditions surrounding it. Various phases of industrial relations work will be briefly described here and examples cited of their use. A study of the needs of the individual concern, and a sincere endeavor to meet those needs in the best interest of management and workers cannot help but have far reaching influences for good.

The Man in Charge of Industrial Relations.—The head of the industrial relations division should be a keen student of human nature. He must understand men and inspire confidence, as perhaps the hardest part of personnel work is to win the confidence of the individual worker, to make him see conditions in a clear, undistorted light and to help him to help himself. The head of the industrial relations division must naturally be an enthusiast over personnel work, but he must not be visionary. His aim must be to win cooperation, to see

that each and every employee gets a square deal and that, in turn, the company gets a square deal too.

As the effectiveness with which each and every function of a business is carried out depends upon the relationship existing between employer and employees, personnel work is concerned with every phase of business activity. Perhaps the chief responsibility of the man in charge of personnel work is to enlist the cooperation of the supervisors in charge of the workers. To do this he must win the support of the division heads by showing an interest in all problems involving human relations in their respective divisions. No matter how fair and square a company's industrial relations policy is and how sincere and untiring are the efforts of the head of the personnel division, they can be completely nullified in so far as the individual worker is concerned, by a foreman or supervisor who is a surly or unfair individual who does not make his actions comply with the spirit of the company's policy in regard to their employees. In more than one concern an elaborate and costly personnel program has been worked out, a separate department set up for carrying on industrial relations activities and a man well trained in personnel work placed in charge, only to have all efforts go for naught due to lack of cooperation on the part of department heads and division heads.

The man in charge of personnel work cannot do effective work alone. It is the everyday treatment of workers by their supervisors that determines what the relationship between workers and employer shall be. The man in charge of personnel, through his study of human problems, can give suggestions and by force of example point the way for the supervisor, perhaps unconsciously, to follow. This is where the effective work of the real leader is shown. By his sympathy and tolerance based upon a sensitive understanding and appreciation of other people's motives and desires, he can help the supervisor in solving his problems and so win cooperation from the supervisor. In fact, many a foreman or supervisor who at first considered personnel activities as just "more new fangled notions" has been diplomatically brought around to a realization of the practical value of such activities and even to the point of view where he thinks the ideas have been his own.

Employment.—Scientific selection of workers is an essential requirement in any business both from the standpoint of the welfare of

the worker and of the employer. In so far as conditions permit, the applicant for a position should be placed at the kind of work for which he is best fitted by health, experience, natural aptitude, intelligence and training. Such selection and placement of workers lays the foundation for a contented and efficient working force, and does much toward the elimination of labor controversies and a reduction in the rate of labor turnover.

Many concerns are reluctant to take away from the foremen their right to hire and fire. The management hesitates to disturb the old order of things. Industry, however, has gone through such revolutionizing changes, and is so very different from what it was even twenty-five to fifty years ago, that the old order of things is no longer effective. Changes must be made, but these changes should be and, in most cases, must be made slowly and with a considerable amount of tact and diplomacy. No one with the peace and well-being of a plant at heart would suddenly force the foremen or other supervisors to surrender prerogatives they have long considered theirs. Such a course of action would only set up an almost insurmountable obstacle in the path of progess.

To eliminate any chance of fancied or real grievance on the part of the foremen or supervisors, the first step in establishing an employment office is to educate the foremen, to make them realize that instead of trying to take away their rights the management is, in reality, relieving them of some of their burdens, and so giving them more time for their true work,—the operation of their shop. The proper sort of foreman will appreciate the common sense of such a move on the part of management and will be willing to cooperate. If he had been ruthlessly forced to give up a right that had long been his, he would no doubt, openly or otherwise, have set every possible obstacle in the path of the employment manager. When the real worth of centralized employment is explained beforehand to the foremen and other supervisors, the only ones with whom trouble can be expected are the "czar" foremen who cherish their right of hire and fire above all others, and those who have been in the habit of getting a little "rake off" each week from the pay envelopes of the men they hire. Happily for industry, such men are in the minority, and every year sees fewer of them as human relations in industry come nearer to the plane that they should be on.

It is of decided advantage if the one who interviews an applicant

for a position has himself had experience in a similar position, and can talk the language of the trade. For this reason, a company employing a large force of men will have several interviewers, each interviewing those applicants who apply for a position in the particular field of work in which that interviewer has had practical experience.

Job Analysis and Job Specifications.—The interviewer does not have to depend entirely on his knowledge gained through experience. He has invaluable tools at his disposal in job analysis and job specifications. A job analysis necessitates a detailed study of the particular job, breaking down that job into its several operations, so that every part of it and the surrounding conditions or factors which affect the job are revealed and made clear. A job analysis further includes information in regard to wage scale, working hours, promotions and all other facts pertinent to the particular job. A job specification is ordinarily a summary of a job analysis gotten up in as simple a form as possible, yet containing all the essential information necessary to aid the interviewer in selecting the proper person for the particular job. A job specification will cover the name of the job, nature and kind of work, skill or particular knowledge required, working conditions, type of worker best fitted for the particular job, rate of pay at start, and scale of wage increase and opportunities for advancement.

The job specification is valuable not only in that it supplements the knowledge of the interviewer, but also that it furnishes accurate data regarding the job itself, working conditions, etc., which the interviewer can use in explaining the job to the applicant. It is the duty of the interviewer to sell the job to a desirable applicant. He must be very careful, however, to be sure that his statements are correct, otherwise the applicant may accept and afterwards quit when he finds conditions different from what he had been led to expect. In guarding against such a condition the use of the job specification tends to reduce labor turnover.

Budgeting Labor Requirements.—Only too often hiring is more or less of a hit or miss proposition, a rush order comes in from one of the shops, a Gisholt or Jones and Lamson operator, a pattern maker, or a general shop helper is needed immediately. What happens? The first applicant who is at all fitted for the job is accepted.

OCC'N NO. .... GR. ....
DATE ....
FILLED IN BY ....

OCCUPATIONAL DESCRIPTION
SHOP WORKER

I IDENTIFICATION

Occupation .... Dept. ...... Section ...... Bldg. ...... Floor ....
Other Names for Occupation ....
Number in Occ'n in Dept. .... Number of Subordinates ....

II NATURE OF JOB

Operations to be performed ....
....
....
....
....
....
....
....
....
....
....
....
....
Machine Work ....
Materials ....
Tools .... Personal Tools Required ....
Responsibility for work of others ....
Other Responsibilities ....
Time required for an experienced worker to learn our methods ....
Time to train unskilled worker ....

III WORKING CONDITIONS

Location	Time	General	Peak Load of Work	Fatigue	Posture	Motion	Accuracy	Operation	Unpleasant
Inside Outside Overhead Underground Solitary Group	Temp. Perm. Daytime Night Overtime Holidays Sat. P.M. Sun.	Floor Bench Mach. Tech. Blue Prints Contact with Public Contact with other Depts.	Constant Seasonal Fluctuating Daily Weekly Monthly Periodic	Heavy Light Very Small Moderate	Standing Sitting Stooping Walking Climbing	Moderate Quick Slow	Fine Coarse Exacting Fair Immaterial	Varied Routine Automatic Monotonous Hazards Why?	Dirty Greasy Hot Cold Acids Fumes Dusty Wet Noisy Nerve Strain

IV HOURS Start .... to .... Noon .... to ....

V PAY Piece Work .... Gang Work .... Day Work ....
Range .... Range .... Range ....
Approx. Earnings .... Approx. Earnings .... Approx. Earnings ....

VI RELATION TO OTHER OCCUPATIONS Dept. ....
Jobs naturally leading to this work ....
Jobs utilizing experience gained in this work ....
Promoton to ....

(Courtesy of Western Electric Company)

Figure 58-A. An Illustration of a Job Specification (page 1)

SHOP WORKER (Cont'd)

THE WORKER

Male..........Grammar School..................Business School..................

Female.........High School.....................College........................

Either.........Tech. High School................Tech. College...................

Reason for Ed. Spec. ....

Skilled....................Semi-Skilled....................Unskilled.............

Nationality...

Why?..

Age Limits...........to........... Preferred...........to...........

Why?..

Special Physical Requirements above Physical Examination.

Height......................... Immaterial......................

Weight......................... Immaterial......................

Strength....................... Immaterial......................

Reach.......................... Immaterial......................

Eyesight....................... Immaterial.........Glasses?.......

Manual Dexterity............... Immaterial......................

Actual Working Experience Required......................................

....

Special Educational Experience Required.................................

Special Personal Qualities (State in specific terms—not generalities)

Appearance and Manner................Accuracy...................

Leadership...........................Neatness...................

Cooperation..........................Reliability................

Initiative...........................

Turnover..

....

Common Reasons for Leaving..

....

Points Not Covered Above (Such as marital status, right or left-handedness, etc.)

....

....

....

....

....

....

Figure 58-B. Page 2 of the Job Specification shown in Figure 58-A

Positions are rarely filled satisfactorily when employment is done on this hand-to-mouth basis. In the case of the Gisholt operator, the Gisholt lathe may be standing idle as there is no one to operate it, and production on other machines may be held up as they require the output that should come from the Gisholt machine. Naturally, an applicant who says he has had experience with a Gisholt lathe is engaged as quickly as possible with few questions asked. It may be a fortunate selection and he may prove an efficient turret lathe operator but such men are not common. More likely he turns out to be an ordinary lathe hand who may know something of a Gisholt or Jones and Lamon turret lathe, but is not the specialist required for that type of machine.

Close cooperation between the operating division, the production engineering division and the employment office tends to do away with this wasteful and inefficient habit of getting workers in a hurry at the last minute. We plan for future raw material and equipment requirements, thereby greatly reducing costs and speeding up production. The same good results can be secured through intelligently planning for labor requirements. If on October first a schedule calling for a 25% increase in production is to be put into effect, then it should be figured out the number of additional men required in each shop and the kind of men that will be needed to take care of this increase. Some of the positions to be filled will probably call for special training. If so, this fact should be taken into account in planning whom to hire and when to hire. If it is known on August 1 that the 25% increased production is to go into effect October 1, it certainly would not pay to hire the additional number immediately and pay them to sit idle for two months.

For those positions requiring men with certain definite training, it may be policy to hire men with as much of the required experience as possible and give them some additional training so that they will be up to the desired degree of proficiency by October 1. In calculating for labor requirements, allowance must also be made for those that fail or become discouraged and leave during the training period and so must be replaced. It is possible to figure labor requirements to a man, but that is not always practical. A certain percentage over actual requirements is provided as a leeway to care for everyday shop happenings. In those shops or operating centers where records show the rate of labor turnover is high, a higher percentage over

actual requirements is allowed than for those centers or shops having a low rate of labor turnover.

Labor Requisition.—Just as a stock requisition is necessary in order to get materials and supplies from the storeroom and a purchase requisition is necessary to authorize the purchasing agent to purchase the required materials, so labor requisitions signed by an authorized person should be sent to the employment office when additional workers are required. The form which the requisition takes depends upon the needs of the company for which the form is being drawn up. Some companies use quite elaborate forms covering all qualifications necessary to fill the job, wage rates, etc. Such forms require considerable time in filling out and as the one making the requisition is usually quite busy with other duties, the forms are frequently filled out inaccurately, not so much due to carelessness as to the fact that he has not the time to give sufficient thought to the answer to each question. Other concerns give to each foreman, division head or other authorized person a book containing the specifications for those jobs for which they are authorized to make requisitions. Each job specification has the name of the job and the number assigned to it printed clearly at the top of the page on which the specification is given so that it can be readily found.

When, for example, a foreman needs an additional man in his shop or needs to replace one, all he has to do is to look in his book of job specifications and find the name and number of the particular job he wishes to fill. The name and number are both required so that one is a check on the other. He then writes this name and number, together with the date of making the requisition and the date the new worker is required, on the labor requisition form and signs his name, and if the approval of the superintendent is needed he also signs his name. The foreman does not have to go to the trouble of stating the qualifications necessary, as the employment office has a duplicate copy of job specifications.

If four copies of the labor requisition are made, one can be retained by the one making the requisition for his records, and the other three sent to the employment office. When the interviewer selects a man for the job, he writes the man's name on the original requisition and sends it with the man to the foreman. If the new man is acceptable the foreman signs his name in the space provided

and returns it to the employment office for their record. If the new employee's name and other necessary data are then added to the other two copies, one can be sent to the timekeeping section and one to the payroll section as notice of the hire. In this way, the labor requisition form is made to serve several purposes.

Sources of Labor Supply.—A source of labor suitable to fit the needs of a company, and the way to go about securing that labor depend upon the kind of labor needed and the availability of the class needed in that locality. The efficient employment manager develops contacts that are particularly desirable for his company. If a large percentage of the workers are from among the foreign born, a personal acquaintanceship with the priest and other leaders among the foreign born element in that community is of considerable value in securing a sufficient number of workers of the right sort and in maintaining a contented working force.

By far the greater number of labor troubles are due to misunderstandings. Especially in dealing with the foreign born, labor difficulties often arise due to misunderstandings over trivial matters. These may grow to alarming proportions if allowed to go unchecked, or if the company tries to settle them in their own way without appreciating the foreign viewpoint. Many of our foreign born are of an emotional temperament and quickly sympathize with one another over a real or fancied grievance. The leaders in the foreign born communities have a better knowledge of the early training and environment of the foreign worker and his consequent reactions. If the employment manager is in the confidence of the leader of the foreign born workers he can explain to him the entire situation. A few words to the foreign workers from their leader will then wipe away the misunderstanding and retain the services of the workers for the company. The company gets the name of being a good place to work, recommended to them by their leader. That is enough for the foreign born worker, he stays there himself, a contented worker, happy in having his job and he advises his friends to come there too.

1. Source of Technical Men.—Some concerns requiring the services of technical men send representatives to the various technical schools to offer to a certain number of students about to graduate an opportunity to become associated with their organization. Such concerns feel that by selecting technical graduates with the necessary

personal qualifications they secure the best advantage from their services, as they can develop them along their own lines. These concerns feel that they want to secure their men before they have had a chance to get set in their ways or have acquired methods of doing work in other plants which may not apply in their plant. It is frequently hard to get a man to change his ways after he has followed certain methods for a number of years.

Other concerns requiring technical men prefer men who have been out of the technical schools for several years. As one executive expressed it, "I let the other fellow pay for training my men. I select my men from among those applicants who have worked for a sufficiently long time with other concerns in our line that I know are under good management." The policy of employing carefully selected men from among the graduating classes of technical schools has proved very successful for a number of our well-known concerns, and it is a contact which is securing more and more attention by up-to-date managers.

2. **Records of Former Employees.**—If records are kept of former employees, frequently there will be found a case of a good workman who through no fault of his own was laid off or had to leave voluntarily the employ of the company. Such a man is often very willing to return and in fact feels it is a mark of appreciation for which he is grateful if, when there is a vacancy in a position similar to the one he formerly held, the company offers it to him. Under such circumstances the company gains through the goodwill of the employee and the fact that he requires little or no training. The goodwill alone is invaluable, as it spreads to other workers who feel the company has an interest in their welfare even after they are no longer in its employ. The fact that the employee is trained in the shop's method of work materially reduces costs, as there is no expense required for training him, no wastage of material during a training period, less disturbing influence incident to the coming of a new worker into the shop, as he is already known to at least some of his co-workers, he knows shop conditions and facilities and does not have to ask questions of his fellow workers regarding them. Then, too, the former employee readily adjusts himself to his old work and soon reaches his maximum production. In fact, stimulated as he is by what he feels is square treatment and appreciation of his old work,

he frequently surpasses his former effort and sets a new mark of accomplishment.

3. Employment Agencies, Newspaper and Magazine Advertisements.—As to the value of employment agencies and newspaper and magazine advertisements as a source of labor supply, it depends upon the class of workers required and the medium used. Reputable employment agencies specializing in the placement of certain classes of workers perform a good service. Care must be exercised in the selection of the agency to use, however, as some are so interested in the fee received for placement that they may endeavor to place applicants without sufficient regard for the fitness of the applicant for the job. In regard to newspaper and magazine advertising, they are of considerable value for certain classes of workers due to the number of persons reached. Care should be used in the wording of the advertisement and the medium to use. Common sense would dictate that an advertisement for an ordinary mechanic should not be run in a highly technical magazine and that, likewise, a high-grade electrical engineer would hardly look for notice of an opening among the want ads of a newspaper, the circulation of which is chiefly among the laboring class. Likewise with the wording of an advertisement. One company discontinued all advertising through newspapers for workers as they said their records had shown that it was not successful. They gave as an example one advertisement in which they had 249 replies with only one satisfactory workman secured from the lot. They cited the cost of sending so many notices to come for an interview and the cost of the interview itself. The truth is they did not properly word their advertisement.

If a company wants a man to do finish grinding on wrist pins, for example, where the accuracy may be held to a half a thousandth of an inch over size and nothing under and taper of one thousandth in four inches, they would hardly advertise for simply a grinder. If they did, they would probably get many applicants who were capable of doing rough cylindrical grinding, but were not the A No. 1 cylindrical precision grinder needed for grinding wrist pins. If the plant does not have the right man for grinding wrist pins, production may be greatly lowered or there may be a big increase in scrap, hence care must be exercised in selecting the man to fill the job. Where newspaper advertisements fail to secure the desired men,

it is very often due to the wording of the advertisement. An advertisement that misleads, no matter if it is unintentional, is not only ineffective for the employer but is a source of annoyance, expense and considerable disappointment to those applying for the position.

4. Unsolicited Applicants.—Some concerns depend for their workers upon those who appear unsolicited at the employment office, others maintain that the majority that apply are floaters or at least are of a more or less undesirable type. Certainly any applicant for a position should be given the courtesy of an interview, and if he appears to be the sort of man who would probably prove to be a good workman, he should be given a trial if there is a vacancy. If not, his name and address and a brief history of his previous experience should be taken and filed with the names of similar applicants in what is commonly spoken of as the waiting list. While such a list does get out of date and is not truly indicative of available labor due to the number of applicants who secure positions elsewhere after making their application, it has proved of practical value in many instances.

Some concerns file the cards in their waiting list according to jobs, others file them alphabetically by name of applicant placing different colored signals to indicate different qualifications. The place of the signal on the card indicates the position for which the man is applying as the top of the card is numbered, each number indicating a specified shop or operating center. For example, number 4 may be the forge shop, number 6 the machine shop, number 10 the paint shop, and so on. A red signal on number 4 may indicate the position of operator of a 5000 pound forge hammer, a green signal on the same number may indicate the position of a helper in the forge shop. With a glance at the file, all cards of applicants for a specified job can be readily found, due to the color and position of the signals. There is a difference of opinion among employment men as to practical value of maintaining a waiting list. Some maintain that they are of little or no value, others use them very successfully. Among the latter a common practice is periodically to send out a form letter or card to all names on the list asking whether the person is still interested in having his application on file. By taking from the file all applications of those that answer in the negative or those who do not answer at all, the file is kept clean

and up-to-date, and is often a quite valuable source of labor. Many a concern has built up a reputation that attracts labor to them by giving the courtesy of an interview to each applicant and by notifying those on their waiting list when vacancies occur.

5. Recommendations from Present Employees.—Another source of labor is through recommendations from present employees. Some concerns give a bonus to employees for each new employee obtained through them who stays with the company a designated length of time. The average worker, who likes his job and the conditions surrounding it, is anxious to have his friends and relatives work there too. Many times, excellent workmen are secured in this way. Certain dangers may arise, however, and they must be guarded against. Cliques may form and unpleasant rivalry set up between different cliques. Then, too, if a workman is discharged for any reason, his friends and relatives may resent it and leave with him. Such a condition has been known to become quite serious and even temporarily to cripple the particular operating center in which the trouble occurred. The writer has in mind a concern that retains a very unpleasant and inefficient worker solely because a number of the members of his immediate family and relatives are also employed there and the family is known to be very clannish. The rest of the family are unusually fine workers and the company feels it is to its advantage to pay the inefficient worker an unearned wage rather than run the chance of losing the services of his relatives. The danger to the morale of the working force as a whole if such a policy were extended is at once evident.

6. Transfer and Promotion from the Ranks.—Before an attempt is made to secure outside men to fill a vacancy, effort should be made to find a present employee who is qualified for the position. Where work is monotonous an employee will frequently go stale on a job. If transferred to a job in another line of work he may prove an excellent worker. Such a transfer is of advantage to both the employer and the employee. The company retains a good workman at practically no cost to itself. If he had stayed in his old job he probably would have gotten so tired of it that he would have quit or, being stale, his production would have so slumped that he would have had to be let out. For the employee, the transfer gives him work to which he is better adjusted, he is happier and more content. In

other words, his entire outlook is brightened as there is zest in his work.

Similarly, where there is lack of work in a department, the employment office should try to retain these trained workers in the employ of the company by transferring them to jobs that are open in other departments. Likewise when for one reason or another there is friction between a worker and his immediate supervisor. There are instances where a man may be an efficient workman but he cannot get along with his boss. Rather than lose his services, it is advisable to transfer him to another job under another supervisor. Some men work well under one type of supervisor and not under another.

Promotion Fosters Loyalty.—Undoubtedly the two factors in employment most conducive to loyalty on the part of the working force are an adequate wage rate and the opportunity for advancement. We are all familiar with plants where the majority of good positions are reserved for relatives of the management. If one looks back over the history of those plants, one is struck by the fact that all have one feature in common, the loss of good men who sought positions elsewhere when they became awake to the fact that they could never expect to reach the higher positions in the company, regardless of the amount of effort expended. The writer has in mind one organization which was almost completely demoralized by the promotion of the new son-in-law of the general manager to a very responsible position. He had for several years held one of the junior executive positions. His immediate associates, knowing him to be of but mediocre ability and insufferable in his conceit, resented his promotion, especially as other men, and especially one man in particular, were in line for promotion and well qualified for the position. The feeling spread all the way down the line and gradually one then another left to go to other concerns with a reputation for fair treatment and promotion based upon proved ability.

Several points should be emphasized in considering the question of promotion from the ranks. While the employment office is a logical source of recommendation for transfer or promotion, such action should always be subject to the approval of the division head or section head in charge of the person in question. The average foreman or supervisor is interested in his men as individuals and

is pleased to see one of his men better himself. In fact, most recommendations for promotions come from the man immediately in charge. Occasionally, however, a supervisor will lose sight of the welfare of the man and consider only the interest of his shop or division. Such a supervisor is reluctant to part with a good worker and does not always afford him the opportunities for advancement that he should have. It is up to the employment office to guard against such treatment both in the interests of the workers and of the company.

A company always benefits from the development of its working force and, vice versa, suffers when such development is retarded, as the worker either gets discouraged and goes stale or leaves the employ of the company. Another point that is worth consideration is the occasional need of new blood. There are instances where a working force gets so contented that they are going stale and need the jolt of having an outside man brought in to fill a desirable position that is vacant. Likewise with the seniority rule. Length of service is always a factor in considering an employee for promotion but the deciding factor must be the fitness of the individual for the particular job.

Bases of Rating.—In considering the question of promotion of employees, brief mention should be made of the subject of rating. Certain comparable measures of ability and fitness must be adopted and employees rated by them if promotion is to be made fair to all. Records of length of service, tardiness and absence, quantity and quality of work produced are already kept somewhere in the records of the modern industrial plant, probably in the timekeeping and payroll records. Such information, when available for all eligible for a given position, makes rating from such a basis equitable to all. Then, in addition, due weight would have to be given to those traits and characteristics which do not lend themselves to objective measurement, namely, traits of personality, character, morale-building ability, etc. There are in use various efficiency records, rating scales and that sort of thing, but the value of many of them is questionable. Some, while technically good, require experts to use them, and as the average foreman or supervisor who is asked to rate those under him is not trained in rating, he does not understand the significance of the various factors involved. Then, too, foremen and supervisors ordinarily are rather pressed for time with their regular duties, so

put off sending in their reports covering the ratings asked until they are forced to do so by continual pressure being brought to bear upon them. They do not have the time carefully to weigh and consider before answering, so put down a rating hastily, invariably marking high so as "to be on the safe side." Ratings done under such conditions are rarely satisfactory.

A simple rating plan worked out to suit the particular needs of a company can be made of value, provided those who are to do the rating are interested in rating and are willing to give the required time and thought to make the ratings reliable and worth while. Probably the reason that the average rating system is not of practical use is that it is too pretentious. Most of the information needed in judging the worthiness of an employee for promotion is already a matter of record and merely needs looking up. Rating, as with all other systems, should be made as simple as possible, emphasis being placed not on the method of rating, but on the object to be derived. If the method does not produce ratings that are of practical use, then it is not worth the cost and should be done away with, for it is of no use in itself no matter how fine it is in theory.

The Interview.—Under the heading of the interview it might be well first to consider that which should be self-evident but is sometimes neglected, namely, the impression made upon the applicant by the appearance of the employment office. If the employment office is a dark, dingy room in an out-of-the-way part of the plant, it makes a bad impression upon the applicant who is likely to judge the plant itself by his first impression gained in the employment office. Similarly, if the applicant must find his way through the shops. A man looking for a job feels self-conscious if he has to stop and ask employees for directions. He often will be so embarrassed that unless the need of getting a job is urgent he will go elsewhere rather than try to find the employment office. The office need not be pretentious, but it should be located in a convenient place so that it can be readily found by those seeking a job, and it should be well but simply furnished.

A comfortable waiting room in which the applicant can await his turn to be interviewed adds much in creating an atmosphere of pleasant surroundings. Likewise, a few magazines and newspapers are of use as they give the applicant something to do while waiting. This

serves to take his thoughts away from himself and his need for a job. If he sits there wondering as to the questions that will be asked and figuring out the answers he should give in order to make a good showing, by the time it is his turn to be interviewed he is in a rather nervous state and cannot possibly be at his best. The waiting period should be as short as possible so as not to consume unnecessarily the applicant's time, and as pleasant as possible so that he will not feel at a disadvantage, or become restless and leave. Another point that is important is that the waiting room should be so located that applicants will not come in contact with workmen who are leaving the employ of the company. A workman who has been discharged or has quit over a difficulty with his foreman or some other grievance can, if he wishes to, do much to hurt the reputation of the company among the applicants he comes in contact with. A separate entrance removes the opportunity for any such contact.

The Interviewer: His Qualifications and Method of Approach.—Every applicant should be met in a businesslike manner and given the courtesy of an interview. It is most discouraging for a man to tramp from plant to plant only to meet with a curt "Nothing doing," or a sign, "No Workers Wanted." Many concerns have a person with the proper personality for such a position, greet every applicant and give him a very short interview in which it is determined whether the applicant is a promising one, and if so he is then turned over to the interviewer who has charge of interviewing all applicants for that particular class of work in which the applicant is interested. This method serves to weed out undesirables and to conserve the time of both the applicant and the interviewers. In cases where the applicant appears to be a good class of workman but there is no opening at the present time, the interviewer may take down the name, address and telephone number, telling the applicant he will be notified in case of a vacancy. In some cases interviewers even go so far as to tell an applicant of a probable vacancy in another concern when there is no opening for him in their own plant. Such courtesy is much appreciated by the applicant and helps to build up the goodwill of the concern. The value of goodwill, while intangible, cannot be overestimated in dealing with labor.

As to the qualifications of the interviewer—he must be tactful, sympathetic and patient, interested in people, yet not one who is

unduly swayed by his emotions, as he must be at all times level-headed. A knowledge of the jobs for which he hires, based upon actual experience is invaluable, and should be made an essential part of the qualifications necessary for the position of interviewer when such a course is practical. Unless the number employed is very large, however, it would hardly be practical to have a sufficient number of interviewers to permit of an interviewer selecting only for such positions as he has had practical experience in. If the interviewer has concrete knowledge of the general class of work for which he hires, he can augment this knowledge with the data on the job specifications and thus be in a position to judge quite accurately the fitness of an applicant for a given job.

The interviewer should have the faculty of making a stranger feel at ease. The average man is not at his best when he is looking for a job. He is inclined to be nervous and self-conscious and needs someone to talk to him who will put him at his ease. The experienced interviewer is quick to notice nervousness on the part of the applicant just as he is quick to recognize the braggart. He knows from his past experience that a man of the first class can probably do better than he appears to be able to do and that the man in the second class who says he can do everything should have his statements taken with a grain of salt.

The interviewer should be very careful of his general attitude toward applicants. He should be careful that he does not give the impression of patronizing. An applicant for a position expects to have to qualify for it and to earn his wages if he secures it. He is not looking for nor expecting a gift, hence does not want to be met in a patronizing attitude. Likewise, if he is met in a too conciliatory manner, as he is only human, he begins to wonder why the interviewer is trying so hard to get in his good graces. This either makes the applicant feel he is a most unusually desirable applicant, and so he asks for a higher wage than he had expected to or he gets suspicious of the job and feels he does not want it. Equally wrong is an overbearing attitude on the part of the interviewer. If the better class of workmen are met by an interviewer with an overbearing manner, they immediately feel that it is not a good place to work. The only ones who accept a position under such circumstances are those who have been unsuccessful in so many places that they take the job as a last resort, or those weak creatures who are afraid to say

THE MIDVALE COMPANY

APPLICATION FOR OFFICE EMPLOYMENT

Name .... Date ....

Address .... Telephone No. ....

Age ...... Height ...... Weight ...... Nationality ...... Where Born ....

Underline the position you desire and are competent to fill.

Clerk	Comptometer Operator	Chemist	Draftsman
Bookkeeper	Stenographer	Metallurgist	Photographer
Timekeeper	Typist	Civil Engineer	Nurse
Cost Clerk	Telephone Operator	Mechanical Engineer	Printer
Salesman	Telegraph Operator	Electrical Engineer	Detailer
			Tracer

Salary Expected $ ...... per ...... Worked here before .... Married / Single

Languages you speak .... Languages you write ....

Grammar School .... (Graduate, or to what Grade?) High School .... (Graduate, or how many years?)

College .... Year Graduated ....

Degree .... Other Education ....

PREVIOUS EMPLOYMENT, ETC.

Give names and addresses of previous employers, position occupied, time engaged, and reasons for leaving.

APPROXIMATE LENGTH of SERVICE	NAME AND ADDRESS OF EMPLOYER	POSITION OCCUPIED AND WHERE LOCATED	Salary Received		Name and present Address of person under whom you worked	REASONS FOR LEAVING
			Amt.	Per		

Write a letter on reverse side in your own hand-writing. Applicants for employment as detailer or tracer should make a small mechanical drawing.

(Courtesy of Midvale Company)

Figure 59. An Application Blank

no to anyone. Both of these classes of men are far from being the calibre of men who go to make up a good dependable working force.

Application Blanks.—There is a difference of opinion among men interested in employment work as to whether an applicant should fill out his own application blank or whether the interviewer should write in the answers while he is conducting the interview. Those favoring the first method feel that it saves time, for if a printed form is provided the applicant can make it out while waiting for the interview. If the interviewer then has opportunity to read over the answers before the applicant is sent in to him, he can get a good general idea of the man's qualifications, his education, general intelligence, past experience, etc., and does not have to ask so many questions during the interview.

Others maintain that the interviewer should fill out the form, for if the applicant is allowed to he may color the answers where it is of advantage to him. If his work at one concern was not satisfactory he may not put down the name of that concern in giving his experience record, changing the length of time spent in other positions sufficiently to cover up the shortage that would otherwise appear in his record due to not including that particular position. If he were asked regarding his experience during the interview and the questions were carefully placed, he would be more likely to tell the exact truth. Another argument given is that some applicants, while well qualified for certain positions, have not gone very far in school and are rather embarrassed by the poor showing they make when they have to express themselves in writing. Others resent certain questions when printed which it is felt they would not resent if not asked so directly and bluntly. For example, a man might resent questions being asked as to his financial condition, but would not resent having the interviewer in a conversational way bring out the fact that the man is buying his own home, has several children and other information which points out just what the company wanted to know when they asked as to his financial condition, namely, whether he was a settled man of thrifty habits or whether he was a spender and a floater.

Both methods of securing the desired information have their uses. It would certainly facilitate matters to have the applicant, before the interview, write his name, address, telephone number, age,

nationality, certain personal questions as to whether he is married, number of children, etc. Other answers covering questions that it would be better to bring out in a conversational way can then be added by the interviewer. One point should always be remembered in drawing up an application form, and that is that the tendency is to make the form too complicated and to ask for too much information. Brevity and clearness are essential. The applicant resents having a great mass of questions asked him, for he rarely appreciates the true reason back of the questions. To him they are "red tape," and questions about his personal affairs that he feels the company should not ask him about. This viewpoint should be kept in mind and only such data required as are absolutely essential.

References.—When a person applies for a position it is the usual practice to obtain from him a statement of previous employment. This record can then be checked by requesting references of previous employers. A quite common practice is to send a printed form drawn up in questionnaire style similar to the one shown in Figure 60. Other concerns prefer a personal letter stating clearly and briefly just what information they desire. Mr. L. E. Trailey of the Purina Mills in a discussion before the American Management Association [1] reported that he received an unusually frank reaction from a letter in which he wrote, "I would appreciate it if you would give me frankly your opinion of Mr. Smith, because I want to be fair to Mr. Smith as well as to the company. It would be a poor bargain for himself, as well as ourselves, to place Mr. Smith in this position if he is not qualified." Mr. Trailey said that since he received such fine reaction from that letter he has used some such wording at the end of each of his letters and has been very pleased with the result. He feels that by making the man of whom reference is asked see his point of view, he will be frank, honest and even go to greater pains in giving his opinion than he would ordinarily.

As to what value can be attached to a reference depends considerably upon the person writing the reference. The ordinary reference cannot be accepted as conclusive evidence of the fitness or lack of fitness of an applicant for a job, but if a reference giving a high rating is received from a concern known for its standards of workmanship, it counts a long way in securing the job for the applicant.

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[1] American Management Association Convention, New York, February 18, 1927.

_______________CORPORATION
Newark, N. J.

From: Employment Department

To: (Name)................................... (Address)...................................

_______________________________________who has applied to us for a position as_______________________________________has mentioned you as a reference with whom we might confer as to ability and character. Will you be good enough to give us below the benefit of a confidential statement so that we may have reliable information on which to base a decision with regard to employment.

An early reply will be greatly appreciated. Stamped return envelope enclosed.

Very truly yours,

____
Employment Manager

PLEASE CHECK (✓) THE WORD APPLYING IN EACH QUESTION.

Do you consider the candidate qualified for the position named? Yes......No......Doubtful......

How long have you known him?................ How well? Intimately...........Slightly...........

Are you connected with him in business?........... By relationship........... Socially...........

Was he employed by you? Yes......(From..............19....to..............19....) No......

Why did he leave? ....

What were his duties? ....

How well performed? Creditably............ Fairly............ Poorly......................

How do you rate his—

	Very Good	Good	Average	Poor	Very Poor
a. Trustworthiness?	....	....	....	....	....
b. General Intelligence?	....	....	....	....	....
c. Ability to supervise and direct others?	....	....	....	....	....
d. Ability to work with others:					
Employers?	....	....	....	....	....
Associates?	....	....	....	....	....
e. Loyalty?	....	....	....	....	....
f. Honesty?	....	....	....	....	....
g. Personality?	....	....	....	....	....
h. Capability of advancement?	....	....	....	....	....

i. What was salary?..............................

For what other class of work, if any, would you recommend applicant?..........................

....

....

REMARKS:

Signed...

....
Position, Business or Profession

Date...................................

(Please make any additional remarks on reverse side)

Figure 60. A Reference Form

Tests.—Tests are valuable in certain cases to supplement the data on the application blank and any information secured from former employers. If one wants to judge the ability of an applicant to do a given piece of work, probably the best way is to give him a chance to demonstrate his proficiency or skill if such a course of action is practical. It is a simple matter to test the ability of an applicant for the position of stenographer or adding machine operator. Where the work, however, takes quite a long time to do or is complex or varied, such a demonstration is rarely practical and if a test is desired, a simple one that can be made in a short period of time must be devised to fit the needs of the case. This may sound like a simple matter but the development of such a test is frequently a highly technical problem. A number of the larger companies have various tests in use but as yet they are in the experimental stage. Various types of tests are used depending upon the capacities to be tested. It is beyond the scope of this book to describe the various methods of testing. Roughly, however, they can be divided into four general classes:

1. Physical tests to determine whether the applicant is physically fitted for the job.

2. General intelligence tests to aid in determining the mental alertness and speed and capacity for learning. These are especially useful in detecting applicants who are below par mentally and those who are unusually mentally alert.

3. Trade tests to indicate the ability of the applicant with regard to a given craft. The test may consist of certain trade questions which can only be answered correctly by one with experience in that trade, again it may be the identification by pictures of various tools of the trade and an explanation of their use, or it may be an actual demonstration of how to do a given piece of work. In some cases a combination of all three methods of trade testing are used. Trade tests aid the examiner in classifying the applicant into one of the grades of trade skill. Thus, the expert will reveal himself by his trade knowledge, his greater skill and dexterity. He quickly chooses his tools and knows exactly when and how to use each one.

4. Special aptitude tests. Under this heading are included tests to determine the keenness of the various senses, motor control and dexterity, tests of strength and endurance. For example, mechanical ability may be tested by giving the applicant a number of disassembled

objects, the applicant to put the parts together so that they will work.

The degree of success obtained in giving a test depends upon both the one examined and the examiner. The one taking the test should be as much at his ease as possible. A person in a highly nervous condition could hardly be expected to produce results that would be a true measure of his ability, hence the importance of the right type of man to give the test. The examiner should explain in a few words the purpose and nature of the test and the manner of performing it. He should be prepared to conduct the test quickly and with an apparent minimum of effort, so that everything goes smoothly and the one examined feels reassured and loses some of his nervous tension.

Final Approval.—In some concerns the employment office has full authority to hire, in other concerns after the interviewer has selected an applicant whom he considers fitted for the job, he sends him to the foreman or whoever made the requisition, for final approval. Where there is close cooperation between those in the employment office and the foremen and other supervisors, there is rarely any difficulty over the selection and hiring of workers. It is only fair to allow a foreman to pass judgment upon those who are to be under his control. If the one selected for a given job by the interviewer is of a type with whom the foreman feels he could not get along very well, it would hardly be good policy to force him to take the man into his shop. Such conditions, however, rarely arise in those concerns where employment is conducted as it should be. Those in charge of selection study the likes and dislikes and little peculiarities of the supervising force and they take them into consideration in selecting. Similarly, the supervisors having had good service from those in charge of employment, have confidence in their selection and rarely refuse to accept those they select.

Introducing the New Employee.—The new employee should be introduced to those with whom and under whom he is to work. The new employee who is hired, given a machine to operate and the materials to work upon and then gruffly told to "go to it and let us see what you can do" feels a big let-down in his happiness over securing a job. He begins to wonder if he is going to like the job, his satisfaction in the new job is over, it is just once more the daily grind. A few pleasant words from the foreman as to the fact that he is glad to know the new man and that he is sure he will like the

work and the men in the shop, and a word or two about working conditions and facilities make the new employee feel the foreman is interested in him. He begins his job in the proper frame of mind, he feels it is a good place to work and if he is the right sort he tries his best to make good. Then and there he is started on the road to being a loyal and valuable employee. Even disregarding the human side, the few minutes spent by the foreman in introducing the worker to his job pay in dollars and cents to the company. A new man is not taken on for a day or a month or even a year. The workmen that are valuable to the company are the loyal ones who take pride in their work and their job and stay with the company year after year. The pleasant introduction pays, it starts the new man right and it is then a fairly easy matter to keep him going right. A poor start is likely to leave its mark for a long time to come. It takes a lot of hard work on the part of the company and the immediate supervisor to remove a bad impression once gained. Courteous treatment and a little kindness pay.

Following Up the New Employee.—While the foreman being in direct contact with the worker, has the real responsibility of making the new employee feel at home on the job, it is well for someone in the employment office, preferably the man who interviewed him, to go and talk with the new employee after a short time, to see whether he has adjusted himself to his new surroundings and that he has been properly placed. This follow-up is not to be considered in any way as a check on the foreman and his treatment of the new employee, but is simply one more example of the service rendered by those in charge of employment and the helpful cooperation that should exist between the foremen and those in the employment office. Labor turnover is greatest in the first few months. The foremen and other supervisors and those in charge of employment can materially reduce this turnover. The foreman can do his part by patiently giving the new employee any instructions he may need and by his manner of making the necessary criticisms, always speaking in a constructive and kindly way. A word of encouragement occasionally, especially during the first few days is greatly appreciated by the very large majority of workers. If in addition the interviewer pays a friendly visit to inquire how the workman is getting along, the worker greets him as one who has a personal interest in him. If for any reason

the workman is dissatisfied or is obviously not properly placed, the interviewer can then talk the matter over with the foreman and, if advisable, transfer the workman to another job. In this way the services of many a good workman are retained by the company when otherwise the workman would quit or be discharged and not only would his services be lost but in addition the cost of placing him and the man who is to take his place.

Discharge.—Practice differs as to the placement of final authority for the discharge of employees. Some concerns give the power of final discharge to the employment section. The foreman or section head who wishes to dispense with the services of a worker sends him to the employment section who, taking into consideration the recommendations of the foreman or section head, the past record of the employee and the conditions of the labor market, either discharges or transfers the worker to another shop or section. No matter what method of discharge is used, every employee severing his connection with the company whether through discharge or voluntary leaving should be interviewed by some designated person in the employment section so as to determine the cause of leaving. In this way valuable employees are often retained who would otherwise be lost to the company, and frequently undesirable operating conditions or unwise labor policies are brought to light.

Discharge of an employee is a serious matter not always fully appreciated. If it occurs in a time of shortage of jobs, to the one dismissed it may mean weeks of job hunting with its accompanying trials and hardships to the worker and to those dependent on him. To the company it often means the loss of the services of a competent workman over a comparatively trivial matter.

For example, in those concerns where the foremen have the power of discharge, there may come a day when a foreman does not feel quite up to the mark or things are going wrong in the shop, a little mistake or a hasty word on the part of a workman and the foreman fires him. After all, a foreman is only human; like the rest of us he is bound to have his off days when things bother him more than they ordinarily would. He may afterwards regret very much the fact that he fired the man, but the damage is done. If the policy were to leave final decision as to discharge to the employment office, a little quiet talk between the foreman and the one in charge of dis-

charge, and then the difficulty would be smoothed out to the satisfaction of all concerned. Close cooperation between the supervising force and those in the employment office tends practically to eliminate injustice due to uncalled for dismissal. When the foreman knows that the employment office stands back of him in all cases of insubordination, violation of company rules and other sufficient causes for dismissal, he is generally very willing to see their side of the question when they may feel he is in the wrong or the workman should have another opportunity to make good. The foreman or other supervisor should have final authority as to dismissal from his shop or division, but ordinarily it is well to leave final discharge in the hands of those in charge of employment.

Labor Turnover and Its Significance.—Too much emphasis is placed on the cost of labor turnover and not enough emphasis on the causes of labor turnover and their significance to the company. Similarly, it is quite common to hear high labor turnover being deplored on all sides in industry, yet there is such a thing as labor turnover being too low, something we do not so often hear about. Workers frequently go stale on jobs which they have held for a long time, or they become so satisfied with their lot that they have no ambition to seek something better. A working force in such a condition is not healthy for the company as it precludes growth, the workers being reluctant to try new methods, as they are too content with the old even when they have it pointed out to them that they are inefficient. A higher labor turnover under such conditions is what the plant and the workers themselves need, for they need the stimulus of new blood. The old employees seeing a new employee using better methods and turning out more and better work know they must do likewise or they will be replaced by those who will. Then too, their pride is hurt; they are allowing a new employee to get ahead of them. They strive to surpass their old efforts if for no other reason than to beat the record of the new man.

When the rate of labor turnover is found to be abnormally high, one of the most useful methods of reducing it is to interview all who are leaving and in that way try to find out the underlying causes. Care must be exercised, however, in the use of the information so received, as the one who is leaving may be biased in his opinions or he may not be telling the whole truth. He may say he is leaving

due to the treatment the workers receive from the foreman when the truth of the matter is that there have been frequent lay offs for which the foreman was not in the least blame, but which the worker attributed to him. Care in questioning the one who is leaving, a study of his employment record (his length of service on the job, his length of service with the company, personal characteristics, the conditions of work, etc.), and an investigation from all angles will generally bring out the true reason. It may be faulty employment methods, or not sufficient training of new employees. Both are often found to be big factors in high labor turnover.

In the first instance, more care should be exercised in selection. In the second instance, more attention should be given to training. Frequently a new employee is left too much to his own resources. He tries his best, but as he sees other employees turning out better work and getting better pay, he becomes discouraged and quits because he cannot do the same thing. A little training would have prevented this, as it is usually just as easy to do a thing the right way as it is to do it in an inefficient way. In fact, the right way is generally the easiest way once the person doing it knows how. Again, the high rate of labor turnover may be due to poor foremanship, bad working conditions, poor planning of work, inequitable pay and a lot of other things, all of which the management should know about, so that they can see to it that they are corrected. Labor turnover figures are of little or no value unless they indicate causes so that they can be corrected or removed. Where they do indicate causes of dissatisfaction they are invaluable, as such sources of dissatisfaction not only cause employees to leave the concern but react unfavorably upon those who remain.

CHAPTER XIX

INDUSTRIAL RELATIONS DIVISION (Continued)

EMPLOYEE TRAINING

Necessity for Employee Training.—Centralized employment and employee training are two classes of work that pay in dollars and cents to the company. Selective employment places the right man in the job, employee training trains the man so selected. He then turns out more work and of a better quality than he would do without such training. The following story written of an occurrence during the World War admirably points out how much can be gained by selecting the right man for the job and then giving him the proper training. To appreciate the story one should know that the number of riveters required in industry is comparatively small, that only men of great physical endurance can qualify for that job and that ordinarily a man requires several years experience to become thoroughly skilled.

In connection with the building of the large number of ships needed for transportation required to meet the wartime needs, while still maintaining the other building industries that were going on throughout the country during wartimes, the number of riveters in industry was soon depleted, and it was necessary, in the ship yards in the East, that they quickly get more from some source. . . .

A Commission was got together to study the problem and see what could be done. To make the matter short, they decided on this program: "Let us get people of the best aptitude we can. We will thus shorten the training period. We will take only high school graduates." (That meant that they obtained men of exceptional intelligence, or above the average, at any rate.) "Second, we will give these men a thorough physical examination and take only the stalwart men—men who can stand the steady pound, pound of the riveting gun." They did that and got them on the job to be trained.

"We must make these men go through a very intensive training period. Let us cut this period down, however, not to a year or even six months,

because we must have them at once, let us cut it down to two weeks, so that the man in two weeks can really learn how to drive rivets!"

So they said, as a part of this intensive method, "For every rivet you drive successfully, we will give you six cents. We will not, however, allow you at the start to make $10 a day, or more, which you can readily do. We want to train you to make $20 a day. Instead we will pay you a flat rate of $6 a day, which will assure you that you will get at least $5 a day (minimum wage), and then we will give you six cents more for each rivet which the instructor allows you to drive, and which you drive successfully. We will do that, with this purpose in mind, that you shall learn to drive rivets under every conceivable condition, every conceivable possible circumstance in which riveters drive rivets. You shall learn to drive rivets 'standing on your head,' over your shoulder, overhead, stooping down between your legs—in every possible position in which the riveting gun can be held. We will point out to you all of the situations riveters are likely to have to meet, just how hot a rivet must be, just what happens if the rivet is too cold, what happens if you do not hold the gun so-and-so, and so on."

The result was that at the end of the two weeks' training, a large number of them did get through, and inside of a very few weeks on the job, they were making forty, fifty, and sixty dollars a day on Sundays, when double time wages were being paid, and many of them were quite the equivalent of men who had been years on the job.

In other words, they got (a) men of high intelligence, men who could learn quickly, men who could understand directions; (b) men of physique or physical aptitude, men who could stand the hard labor involved in that occupation; (c) they gave them an incentive to learn; and (d) finally they taught them not only what is the best way of doing the job but also what are the faults and bad methods to be avoided.[1]

Effect of Productivity on Costs.—Now let us take an example that is a common occurrence in the average industrial plant. A worker may get 40 cents a hundred with the average worker producing a hundred an hour. The machine he works on may be an expensive one and the overhead charge on the product turned out on it may be $2.00 an hour, which would average in this case 2 cents a piece. If the operator can be trained so that he turns out 150 an hour, he would receive 60 cents for his hour's work and the overhead charge would only average 1 1/3 cents a piece. Thus production is increased, the worker is better satisfied as he is making more money and cost of the product is reduced 2/3 cents a piece.

[1] Dr. Herbert A. Toop, Proceedings of Management Week, Ohio University, 1926.

All companies do some sort of employee training, even those that may not recognize it as such. Generally such concerns leave the training to their foreman and other supervisors. A foreman or supervisor ordinarily is quite a busy man, and if he has had no special training in methods of instructing workers he often makes a rather sorry mess of it. This is especially true in times of shortage of labor when many of the workers he has under him are far from being skilled, and he is harassed continually by his superiors for not getting the work out. It is not to be wondered at that under such conditions he fires a worker if he will not learn quickly. The foreman feels he must bend every effort on getting the work out. He begrudges any time spent on training. Under such a strain he probably is not even as good a teacher as he would otherwise be and his impatience only makes the new workers even more nervous and in no state of mind to learn. Some persons are more fitted for teaching work than others. All persons who are to teach others require at least some training in how to put over their ideas and the information needed.

Factors in Employee Training.—The extent to which employee training is carried on in industrial concerns ranges from the simplest form of instruction for a specific job to a comprehensive program of educational training. In determining the general plan and policy for employee training work there are several factors to be considered, namely:

1. The needs of the particular concern.
2. The amount of money and effort the company is willing and able to expend.
3. The classes of employees to whom training is to be offered.
    (a) New employees (entrance training).
    (b) Old employees (promotional training).
    (c) Executives (foremen and other sub-executives).
4. The courses to be offered and the content of each.
5. Whether training is to be voluntary or compulsory.

1. Needs of the Particular Concern.—Conditions in factories are different even within the same type of industry. For this reason, a training program should be developed for each factory to meet the needs of that factory. Even within a factory, the training required

varies in different departments and in different shops and the program should be planned accordingly, so that it will adequately meet the situation. The following two examples show how the Scovill Manufacturing Company, a jobbing shop in brass manufacture, handles their training work to meet two different situations.[2] Being a jobbing shop, the work coming through changes from month to month. They have some work from time to time that is alike, but there will always be a change. The first type of training we will consider is that given for toolmakers.

Toolmakers are specialists on certain lines, for example, one group of toolmakers will make tools for cut and draw work; another group will make tools for work that is pierced and drifted, and so on. The tools for one cut and draw job are very much like the tools for another cut and draw job; the shells will differ in diameter and length, but the tools are on the same general plan. This is true of each line of tools. Under the conditions in the toolrooms at the Scovill Manufacturing Company, it was deemed much better to have a leader in each group of toolmakers, who knew how the tools for the various jobs in his line should be made, and who could figure any of the problems involved in the making of the tools or the article, than it would be to have a separate planning department to do the figuring. The leader could have one of the toolmakers in his gang look up the tools for some other job that was almost exactly like the one in question. Then in a few minutes of explanation he could tell him how to make the new tools, what size and form each part must be. This would take much less time than for someone to figure it out and send in a detailed drawing.

Eighty men were sent in for an initial class in shop mathematics, several of the most skilled men in each group of toolmakers being included. Seventeen were able to make satisfactory progress in shop mathematics. Some of these began to bring the jobs on which they were working into the class to see how they could be figured. It had been taking three days and a half to make one set of tools by the old cut and try method. As soon as the toolmaker learned how to figure the different parts so that he could work to definite dimensions, he began making a set of these tools in a day and a half. This, and a couple of other equally startling jobs, convinced the toolmakers in the

[2] Adapted from a paper presented by Walter S. Berry, Director of Training, Scovill Manufacturing Company, at the American Management Association Production Executive's Conference, held at Detroit, April, 1927.

class that it would help them earn more money if they could figure out their jobs and thereby cut the time it took them to make the tools. The increase in efficiency of a workman means a decrease in the cost of the work he does. The promotion these men received since completing the shop mathematics course tells something of the value of their training to the company. Three of them are now on the mechanical superintendent's staff, two are toolroom foremen, one is assistant foreman, two are tool designers, one is in charge of a specialized line of tool work.

Contrasted with this class instruction method is the individual instruction method used by this same company in the training of toolsetters. The toolsetter is a specialist who learns to set the tools on a very small line of machines. The job of setting tools in one kind of machine is different from setting tools in another kind of machine. The company found that they could not give toolsetters any general training. They had to have specific training for the kind of tools and machines they were working on. A standard practice was worked out and someone placed in the toolsetting section who was familiar with the standard practice. He had to be trained how to teach, so that he could impart the knowledge as quickly and efficiently as possible and get them working on the job. Here we have specific training on the job for the job, by a person who had been on the job, had analyzed it and been trained how to teach it.

Still another kind of training was used to advantage by another company.[3] It was a case of learning by teaching. A young man in the company showed plenty of willingness and a lot of genuine capacity for getting things done, but he was a one-man worker. He would rather work a couple hours overtime than explain a job so someone else could do it. Others tried to help him in the rush periods, but there was not any use. He just had to follow every detail himself. He was a valuable worker, but the men a company needs are the men who can work with others. In a discussion of the case, the man in charge of personnel work in that company suggested an assistant, so while the young man was away on a vacation an assistant was hired and when the young man returned his supervisor insisted that he analyze his job and decide what part of it he could give to his assistant, then explain that work to him and see to it that he did

[3] Charles Loomis Tunnel, Adapted from Learning by Teaching, *Saturday Evening Post*, October 16, 1926.

it. The study of the job so that he could explain it lined up his work for him in a manner that gave him a brand new grasp of it. He had mapped his job, and his productivity jumped. Today he is directing the work of a department and keeping track of every job that goes through his place.

The above three illustrations are only three among a large number of training methods that are being used throughout the country in various industries. In deciding upon an employee training program, the first step is to study thoroughly the needs of the particular concern in question. It is a mistake to install a training program merely because it has worked out well in another concern. The chances are that if it is done, a good part of it will be money wasted as it will not fit conditions. Before working out any training program, however, it is always well to inquire as to the methods used in representative plants, especially in the same industry, for in that way one learns what has worked out under certain conditions, and so gets hints as to what to do and in some cases hints as to what not to do.

2. Amount of Money and Effort Available.—For a small company it would hardly be profitable to establish a training program on any large scale for two reasons, first, such training would probably cost more than the company could afford to pay, and second, there would not be sufficient number of employees to assure success of anything but a restricted program. One point that can hardly be overemphasized in this connection is that in employee training work as in all other personnel work, one should study the needs and go slow to make sure one is on the right track. It is better to begin in one shop or with one class of workers and try out the method of training decided upon, then after seeing the difficulties involved and the opportunities for improvement, gradually extend the scope of the training program. For example, it would hardly be wise to institute a training course involving physics, chemistry, mathematics and similar subjects unless there was someone to whom the employees could go for advice regarding their educational needs and who in cooperation with the line supervisors could determine just which employees were qualified to take specific training subjects. Without such provision, employees would probably register for courses for which they were not properly qualified, with the result that not only would they not benefit themselves by taking the course and so be

disappointed and made discontent, but there would be the wasted time and effort on the part of the instructor and useless expense on the part of the company.

3. Classes of Employees to Whom Training Is to be Offered.—

(a) New Employees (Entrance Training).—A concern, due to the nature of its processes, may require even skilled workers in the trade to be trained along their particular lines. Such concerns endeavor to secure workers of sufficient education and general training to enable them to fit quickly into the work, and then give them the required additional training. Other concerns facing a shortage of the required skilled labor select unskilled men of good character and dependability who show themselves to be capable and willing to learn, and give them the necessary training to make of them skilled men in the trade. Methods of such training will be discussed in the latter part of this chapter.

(b) Old Employees (Promotional Training).—In this day of specialization a man, to give an extreme case, may perform but a single operation. Even if he performs several operations, the repetition of them day after day makes his work become monotonous and he begins to lack interest. Unless he has some additional training, there is little opportunity for transfer or advancement in the average shop. To overcome this condition some concerns give a program of training by which the men can prepare themselves for advancement or for transfer to some other line of work. This is of benefit to both the employee and his employer. To the employee it furnishes him with the training necessary for advancement or transfer at little or no cost to himself but his time. Otherwise, he would have to give up his present job and run the risk of making good at another job, something few workers, especially those with dependents, can afford to do. For the employer it keeps up the morale of the working force by fostering ambition, a desire to learn, and a real interest in the work on the part of the workers, and, in addition, it provides the company with workers for the different classes of work, who are at least partially trained in the worker's spare time.

(c) Executives (Foremen and Junior Executives).—Executives and foremen can very frequently profit from training, especially

such training as will broaden them and give them a better understanding of company conditions. As the men to whom it is desired to give such training may be men who have been in the employ of the company for a number of years, it is sometimes advisable to give the training by the conference method as such training can be so conducted as not to be recognized as such. This method does away with any possibility of resentment such as might be attached to training done by the lecture method. The group to whom it is desired to give the training is called together. They group around the table. The topic that has been planned for that day is, for example, reduction in scrap or discipline—shop problems common to them all.

It will invariably be found that as soon as the subject comes up someone who has recently had that problem before him will relate his experience. Another man will differ in his opinion. That starts the ball rolling and the discussion is well under way. By tactful guidance the one who has charge of the conference can keep the discussion in the channel he wants it in and in the end have what he wants taught brought out by the members of the group themselves. If it is a question of reduction of scrap, those in the group have it brought home to them that every bit of expense in their shops, every bit of material and labor wasted are accounted for. They will then be more interested in methods of cost reduction and the practical application of these methods in their shops. When they see a worker being wasteful of materials or supplies or going through a lot of unnecessary motions, they will see that such conditions are corrected, as they understand and appreciate the effect of such conditions upon costs and know that their shops are having the cost of such wasteful conditions charged against their accounts. A further discussion of such training will be given later under the heading of foremen training.

Training on the Job.—The average workman of today who calls himself an all-round mechanic is flattering himself considerably. Probably he has had six months experience on a few machine tools, but he is far from being an A. No. 1 mechanic. This, of course, is not true of the older mechanics who have learned their trade, but it is true of a great many of our younger men. If a plant of any considerable size would decide to hire only all-round mechanics they would probably seek for a long time before they found enough to fit their needs. To overcome this condition, some training is required.

The sort of training most common is the training of the new employee while he is at regular work on the job. Such instruction is ordinarily given by the foreman or by a skilled workman in that particular operating unit. The foreman or trained mechanic selected for the instruction work talks with the new employee to find out how much he really knows of the machine tool he is to work with and its operation, and then explains what is necessary. If the company does not maintain a set-up man, he will show him how or will actually help him set up the job. Then, if the company has instruction cards he will give the new employee his instruction card covering the proper cutting speeds, feeds and depth of cuts, and will show him what tools are needed. If instruction cards are not supplied the one instructing the new worker will explain to him the required feeds, speeds, etc., and will probably give him an actual demonstration of what he should do. If jigs and fixtures are required, he will show him the best methods of handling them. If the job requires the use of blueprints he will make sure that the new worker understands how to read them and he will explain any fine points about the job. After this instruction has been given, he will start the new employee on his work, returning at frequent intervals to see how he is doing.

Such instruction serves very well if the one who instructs has the required skill, the ability to impart knowledge and the time available to spend in instruction work. In the average shop such a combination is hard to find, with the result that the training given is poorly organized and generally done in a hurry, leaving a good many points for the workman to dig out for himself. This means the worker takes a long time to get up to capacity, and costs rise due to machines working under capacity and the amount of scrap.

To overcome this latter condition some concerns give instructions to their foremen in good instructional methods, so as to guide their efforts in training. Other concerns employ instructors who are training experts. Such men are particularly interested in and enjoy the instruction work, and, moreover, they have the time to spend on such work, whereas the foreman frequently has to give instruction at the expense of his other duties. These training experts can organize their work properly as they have nothing else to interfere with it. They make a study of how to put the facts across and, from their experience with other workers under similar conditions, they know just what reactions to expect. The result is that the new worker

under this concentrated attention learns quickly the proper method of handling parts, of handling the required jigs and fixtures and of using the proper speeds, feeds and depth of cuts to turn out maximum production with a minimum of scrap.

Vestibule School.—The vestibule school is a preliminary training school in which the new employee is taught in the shortest possible time the specific work which he will be expected to perform. He may be trained to be an operator of an automatic screw machine, a drill press, a lathe, etc. In those concerns where there is a fairly constant need for new workers in sufficient numbers to warrant the installation of machines for instruction purposes and the hiring of competent instructors, the establishment of such a school frequently solves the problem of securing sufficient trained labor to fill that sort of need.

For the company with a need for such a school, the vestibule school holds a number of advantages. The training of the new employee does not interfere with normal production in the shop. The new employee learns more quickly, as he is away from any distracting influence of the shop. The workers he is among are like himself, new employees, and he is not made so self-conscious of his mistakes and deficiencies of knowledge. If anything, he has the incentive to work harder and surpass the efforts of his fellow beginners. When he finishes with his training in the vestibule school and he is given a machine to operate in the shop, he feels at home with it. He has confidence in his ability to make good and so does not suffer the disadvantages a new employee without such training would suffer. This serves to reduce the high labor turnover incident to the first few weeks of employment in the average shop.

To have the vestibule school a success, care must be exercised in the selection of the person to be in charge of it. He should be a person particularly fitted for such work, one who can be depended upon to act kindly and in an encouraging manner to all new employees, to be patient in teaching and yet insistent upon the correct method, even to detail. When women workers are used, it is generally advisable to have women selected as instructors for the new women employees. If a woman sees another woman doing a job she is very likely to feel she can do the same as the other woman, but if the instructors are men she may feel that the work is beyond

her strength, or that it is too dirty, or for some other reason it is what she terms a "man's job," and she will be afraid or unwilling to try it.

Apprenticeship Course.—Apprenticeship training should not be confused with training received on the job or in the vestibule school. The latter trains for a specific job; apprenticeship training trains for a craft. Frank Cushman, Chief of the Industrial Education Service, Federal Board for Vocational Education (quoting) before a conference on Apprenticeship in the Construction Industry for the New England States, gave this definition of an apprentice: "An apprentice is a person employed as a learner in a skilled trade, working as a learner, paid as a learner, with the promise of becoming a mechanic in that trade." Modern apprenticeship differs from the old apprenticeship system wherein the apprentice worked in daily contact with and under the personal instruction and supervision of a master of the craft. Apprenticeship training has been adapted to meet modern needs and the great changes that have taken place in industry.

Practically all industrial leaders agree upon the need for apprenticeship training. They realize that by no other way can the ever-growing shortage of skilled workers be made up, but they differ on methods to be employed. Some concerns have their apprentices scattered through the shops working on various jobs assigned to them, moving them from job to job as their training program requires. Other concerns have the apprentices grouped together in a special training room, bringing the work to them, giving them instruction in and having them actually do the variety of work necessary to give them the different kinds of experience they should have. In either case, however, the responsibility for the apprentice training must be centralized if success in the training is to be achieved.

The apprentice must be regarded as a company employee, not the employee of the shop in which he may be learning and working at that time. There must be a distinction always between the learner and the worker. Some concerns look for savings in cost of production through giving apprenticeship training, saying that they pay the apprentice less than a regular worker on a job, yet under a competent instructor the apprentice can turn out practically as much production as the regular man. Other concerns, while they organize their apprentice courses so that the apprentice is as productive as

possible throughout the training period, do not, however, look upon any savings in production costs as a justification of apprentice training. These latter concerns are taking the long-range viewpoint, they are training apprentices today in all phases of the trade so as to have all-round skilled workers in the future. It is probably the concerns actuated by the latter motive who will be most successful in achieving what is the real object of apprentice training, namely, the development of a group of well-trained, intelligent workers—men who know their craft in all its phases and can make practical application of their knowledge. Such men are invaluable in any organization. They form a stable force actuated by the incentive of steady employment and promotion. It is from among such men that our practical leaders in industry must be drawn; they are our potential foremen.

Extensive formal programs of apprentice training, including classroom instruction as well as supervised shop work, involve considerable expense, and would only be advisable where the overhead of administration, supervision, instruction, etc., could be spread out over a sufficient number of apprentices to make the investment per individual apprentice small enough to be worth while. Where a company might possibly be able to absorb only a half-dozen or less graduate apprentices a year, such a program would be out of the question, but where the number was a hundred or more or maybe only fifty, such a program if carefully planned to fit the company's particular needs and painstakingly carried out would probably work to considerable advantage. For the small concern, cooperation with neighboring concerns in that industry, cooperation with various community organizations, and similar arrangements furnish a means of supplying apprentice training and providing the skilled workers they need.

Flying Squadron or Special Squad.—A number of industrial concerns periodically form groups of men selected from among the best workers in the plant and train them to become proficient in all the different operations in the plant. As soon as they master one operation they are shifted to another. In addition, they are given class instruction in policies and methods of management, on the company's time. This method of training has worked out very successfully in a number of concerns, notably with the Goodyear Tire and Rubber Company which has had the plan in operation since May, 1913.

For the worker it is an opportunity to get a thorough technical training and for those with the proper ability, a training for executive work, with good pay while getting it. At the Goodyear Tire and Rubber Company, the members of the squadron receive the regular piece rates for the job on which they are working at that time, with minimum guaranteed day work rate to cover the periods when they are learning new operations.

For the company the flying squadron method has many advantages:

1. *The members of the squad are available to fill vacancies until permanent workers can be secured and to care for emergencies.* This serves to keep production uniform and to disturb the other workers as little as possible in times of vacancies and emergencies.

2. *Goodwill is fostered.* The members of the squad know the business first hand from many different angles. A squad man can counteract the work of the agitator as he knows the truth about conditions and the workers will take his word for it as they feel he is one of them.

3. *The work of the squad man is an example to the workmen with whom he comes in contact.* Other workers will try to do as well as they see him do.

4. *Poor working conditions and bad practices come to the attention of the squad man in the course of his work.* By reporting such incidents and conditions to the management for correction, the squad man serves as a valuable source of information that the management needs and might not otherwise have.

5. *The men trained in the squad aid in handling new problems.* The four hundred and fifty thoroughly trained and adaptable workmen who were members of the Squadron of the Goodyear Tire and Rubber Company at that time, were the solid nucleus about which new organizations were formed, when during the World War the company was called upon to turn out many products which the plant had never made before. In that company, all new methods, new machinery or equipment of any kind are first thoroughly tried out by squadron men and time studies taken before turning over to the production department to be manned by piece-workers.

6. *Men who have finished the squadron course are a source of executives.* The method of training familiarizes them with the opera-

tion of every part of the business, giving them a broad background and in addition they gain an intimate knowledge of the worker's viewpoint which proves valuable to them in their later work.

That the flying squadron method is applicable to concerns of various sizes is shown by the results accomplished by a large corporation like the Goodyear Tire and Rubber Company on the one hand, and the equally progressive but much smaller concern, the Coleman Lamp and Stove Company of Wichita, Kansas, on the other hand. The latter, employing from 1000 to 1500 employes, has had its Flying Squadron plan in operation since the spring of 1924.

Vocational Training.—Vocational training is frequently employed, many progressive concerns availing themselves of the public facilities for such work. The Federal Board for Vocational Education has prepared much valuable information on the subject which is available to all concerns interested.

Special Training Courses.—Special training courses are devised by various concerns to meet their particular needs. These courses range from brief courses of training for office boys to very technical courses. For example, the Standard Oil Company of New Jersey has a brief and intensive course of training to equip boys to give good service immediately as office boys. Additional courses covering various branches of the oil business and extending over a period of five or six years are available for these boys as they grow older in the business. Similarly, young men at their refineries are given an opportunity to learn a trade, and courses in various phases of the oil business are open to them. Likewise, exceedingly technical courses are open to technical graduates whom they employ. In other words, special training courses are devised to fit the particular needs of that company.

The brief discussion following, of three classes of special training work, is given to indicate the variety of work so covered:

I. *Training for clerks and other office help,* covering instruction in the technique of office operations and in the use of office systems and methods. Two general methods are in use, training on the job and in a vestibule school. The latter method is applicable only to large concerns, as in the average concern the number of new office employees is not large enough to warrant the expense of the vestibule

school. W. H. Leffingwell, an authority on office management, believes that without question the most effective place to give training to office workers is actually on the job. Mr. Leffingwell states that there is no task so simple that the method of performing it cannot be improved by proper study. He gives the following six important steps as being involved in the training of clerks.[4]

1. The actual work to be done must be explained to the worker in a manner that will thoroughly impress him with (a) the purpose of the work; (b) the relation of the operation to other work; (c) the relative importance of the various details of the job; and (d) the manner in which it is to be done. This is the beginning of all training, and there are perhaps more companies who take this step than will be found taking the rest of them. But it is only the beginning, and nothing remarkable can be accomplished by stopping there.

2. The best arrangement of the work and the workplace should be taught. If every job is carefully studied, it will be found that there is always one particular way of arranging the work and the workplace that is far superior to others. But this is a matter that can only be determined by deliberate study; one cannot "just naturally" pick it up, and if left to his own devices, the clerk will usually adopt a clumsy arrangement. Many managers, though observing this, hesitate to suggest a change, on the assumption that a person will work better with his own arrangement than with any other, which is, of course, an unfounded idea.

3. The best motions constitute the next step, and they can be only found by the most careful analysis of the work to be accomplished, the nature of the motion required, the element of fatigue, and so forth. Occasionally a worker will, of his own accord, develop a superior way of performing a certain motion, but rarely indeed does one worker develop all of the best motions in an operation. A study of the various methods used at present by different workers will be found suggestive, but ordinarily the observer will be compelled to use his own ingenuity.

4. The next step to be taught is the correct sequence of the motions at a standard rate of speed. Gilbreth has shown that fast motions are different from slow ones, and if one is definitely to learn the right motions, he must at the same time learn to perform them at a standard rate of speed.

5. While the fourth step is being learned, the habit of speed must be developed. For it is strictly a habit. Some people acquire it more readily than others, but all must learn it.

6. Accuracy must also accompany the last two steps, but its final

[4] "The Office Supervisor's Part in Training." A paper presented at the American Management Association's Annual Convention, New York, March, 1926.

development may be completed after the habit of performing the right motions in the right sequence, and at a standard rate of speed, has been acquired. The worker must be taught the points at which accuracy is of the greatest importance, and also where extreme accuracy is not required. The meticulous clerk is often more of a liability than an asset.

That there are great possibilities in the development of standard methods in office work may be realized when it is known that even in the simplest operations there is a right, as well as a wrong way, and that the difference between the two may be startlingly realized in the difference of output under each method. Thus, the clerk without training will rarely be able to affix stamps on envelopes at the rate of more than 1,000 an hour, which works out at about 16 a minute. The standard rate of speed with the standard method is 84 a minute or 5,040 an hour. If one were to observe simultaneously two workers with these different methods, the slower one would appear to be doing the greater amount of work. A look at the output would, however, show at once that this was an illusion.

II. *Courses for salesmen,* both classes in salesmanship and instruction in regard to the product and the manufacturing process, so that the salesmen fully understand the possibilities of the product and can talk intelligently both in regard to the product and its uses. The following two classes in salesmanship are quoted from the announcement of courses given by the National Cash Register Company:

Salesmanship (Elementary)

Meeting nights—Monday—Wednesday—Friday (Choose one night)
Place—N C R City Club, First and Ludlow Streets—(7:30 p.m.)

The history of the cash register and The N. C. R. Company will be brought out in this course. The manufacture of cash registers, from the earliest crude models to our latest and most complete machines, will be explained and discussed. The operation of the registers, what they do, and the importance of each attachment are included in the instruction. This training will be of interest to every employee in our factory whether he intends to become a salesman or not.

Salesmanship (Advanced)

Meeting nights—Monday—Wednesday (Choose one night)
Place—N C R City Club, First and Ludlow Streets—(7:30 p.m.)

For students who have completed the elementary course in Salesmanship or those who understand thoroughly the mechanism of the registers and the functions of the various features. The instruction includes how cash registers are sold; "the approach"; how to investigate store systems

and how to prepare a proposition sheet for a more efficient system. Demonstrations of the different classes of registers are made by the students. How to instruct clerks and other store employees in the use of the register is taught. This course prepares the student for the selling field.

III. *Courses for junior executives,* to develop them and give them a broader conception of their work and of the company as a whole. Men with the necessary technical information and familiarity with routine operations and procedure to fit a given position can be quite readily found, but it is another question to find such men with capacity for leadership. They are invariably wrapped up in the work of their own narrow field and they need to be developed and broadened if they are to become promising material for the higher executive positions, or even properly to fill offices as junior executives. A broad perspective is an essential qualification for an executive. To gain this broadening of viewpoint the junior executive requires in addition to the practical experience gained in his everyday work, a thorough grounding in the elements of business administration and a familiarity with modern principles and practice. He needs to see the company as a whole and to become imbued with its policies and ideals. The far-seeing concern plans to supply this necessary training. It groups its young executives, each with his different training and often widely different points of view, and gives them in so far as possible their training as a group, knowing that contact with one another will do much to broaden them and get them to see the "other fellow's viewpoint" and so prepares them for when, in the years to come, they will, at least some of them, work together as higher executives.

Foreman Training.—One of the most important phases of employee training is foremanship training. The foreman, to be successful, must know many things outside of the narrow field of his own shop. He represents the management to the workers under him and as such should have a good general knowledge of plant conditions so as to be able to transmit intelligently company policies to the workers and to correct any erroneous impressions they may have. A comprehensive program of foreman training would cover instruction in general principles of business, in leadership, industrial relations, the control of production and general plant conditions.

The competent foreman possesses a great deal of special skill and a fund of information from the practical operating standpoint. He

knows just what to expect from his equipment. He knows what that equipment will do and what it will not do. This information he has gained through his intimate contact with the work and equipment. From his past experience he knows just how far he can crowd his equipment with safety. Hard experience has taught him what troubles to expect if he crowds his equipment past that point of safety. He knows what part of his equipment needs most careful handling, what part is likely to go wrong. He can thus use extra precautions with that equipment which requires it, and can quickly locate trouble if it occurs. In regard to having the above qualifications for his job, there are a great many competent foremen in industry. Foremen as a whole are a capable and able group of men. But there is another side of the foreman's job for which the average foreman is not so well equipped. That is for the training of his men. In the very great majority of plants, the only training a worker receives is the training given him at his job by his foreman.

The foreman, due to his own skill, his past experience with that piece of equipment and his knowledge of the job, probably knows more about that job than any other person in the plant, but he fails in that he does not know how to impart that knowledge to the worker on the job. The average foreman has pride in his shop. If the subject is approached in the right way, he will be very much interested in a discussion of the best ways and means of instructing his workers so as to get this valuable knowledge of his over to his men. He will appreciate having pointed out to him methods of instruction that have proved successful in similar cases. The average foreman does not shirk the responsibility of instructing his workers, but he simply does not know "how." In fact, many times he does not even appreciate that he does not know "how." If he does appreciate his deficiency, he is too busy with other shop matters to try to seek out information. He needs to be given assistance in this matter and encouragement. Herein lies the duty of management. The management that encourages its foremen, gives them whatever training they require and shows them by its actions as well as words that it is standing back of them, builds up a force of efficient, loyal and cooperative foremen that is one of the best assets of the company.

A subject in which everyone is vitally interested, as it affects directly or indirectly each and every one of us, is the elimination of waste in industry. The Committee on the Elimination of Waste in

Industry of the Federated American Engineering Societies attributes 50% or more of the responsibility for waste to management. There is no doubt that by proper training of foremen, management could very materially reduce much of the waste that is now chargeable to it. Foremen do not always appreciate the amount of waste going on in their shops. They are likely to consider that as long as all their men are kept busy, the shop is doing as well as they can make it do, and that nothing more can be expected of them. Foremen need to be so trained that they realize that their work is not to be a driver but a leader. The busiest shop is not the most efficient; a shop in which every man is busy every minute may be a poorly managed and very wasteful one. Foremen need to be awakened to the need of studying each job, and each man in the shop and the assignment of work to the proper man. Likewise, they need training in waste reduction through proper methods of material handling, arrangement of work, elimination of avoidable scrap, and the dozen and one other ways common to all shops. When foremen have become awakened to the waste going on around them and see how the application of waste reduction methods improves the operating efficiency and lowers operating costs in their shops, they will interest the workers in waste reduction and will instruct them in methods which will conserve rather than waste labor, time and material.

Foreman Training Plans.—Plans for foreman training differ widely. Before considering those commonly found in practice, it is well to emphasize two points which if not fully taken into consideration will nullify any foreman training program, no matter how intensive or by what method given.

1. *The foremen themselves must be truly interested.* Foremen who attend foremanship classes merely because they are ordered to do so or because they feel they will get in the good graces of the management by seeming interested, rarely gain anything worth while.

2. *The management must stand wholeheartedly back of the training work.* Concerns which train their foremen solely from the selfish viewpoint of making them more valuable to the company, but with no thought to the welfare of the foremen cannot expect to be truly successful. A foreman who is induced to take up training work by the lure of advancement being held out to him holds a bitter feeling toward the company if, after making notable effort, the promised

reward is not forthcoming. Similarly, the best results cannot be expected from a foreman training plan that is put in operation merely because other concerns in that community have adopted such plans and the company falls in line accordingly so as to appear to give their foremen equal opportunities, although the management is not in sympathy with foreman training as such. Foremen are quick to sense such an attitude on the part of management. A training program will succeed only in proportion to the sincere effort expended on the part of both the management and the foremen.

The following discussion of ways and means of foremen training is not intended to be inclusive, but merely to indicate some of the plans followed. Local needs and facilities and the purpose it is hoped to achieve determine the general plan to be followed.

Company Training.—Some of the large concerns prefer to lay out and conduct their own training programs, feeling that in that way the content of the course and the method of instruction can be made more fully to fit their individual needs. They may develop their program after a study of what they feel is necessary, they may follow or adopt one of the several standard foremanship courses on the market, or they may leave the content flexible. In fact, some concerns, after the course is under way and the interest of the foremen well aroused, ask the foremen to suggest topics for subsequent meetings. This serves to create enthusiasm, but unless care is used, it may be at the price of continuity. Disconnected subjects do not give as good a picture as a well-developed and logical sequence of subjects gives. With the latter, material for each subject discussed can be prepared with the view of tying up all subjects to give a picture of the whole. Both the preplanned content and the more flexible type have worked out successfully in practice.

The Instructor or Leader.—An important question in any training is that of the selection of the instructor or leader. Some concerns favor having men from their own organization, others prefer a man from outside the organization who is familiar with foremen training methods. The former is familiar with plant policies and conditions and can drive home the points he wishes to bring out by giving examples directly pertaining to the foreman's everyday work.

In selecting a man from within the organization, certain points must be considered: first, he must be interested in and thoroughly

believe in foremen training; second, he must have sufficient knowledge of the subject or subjects to be discussed; and third, and far from being least in importance, he must have the ability not only to impart knowledge but above all to arouse interest, to develop the men by getting them to think, to apply what is being discussed to their own individual problems and to volunteer information at the meetings. No matter how well-versed in the subject the instructor or leader is, nor how high a position he holds in the organization, the lecture he gives or the meetings he conducts will fall flat if he is not the type that is what might be termed a "live wire," a man that can arouse interest and enthusiasm in the subject.

The value in any form of training lies not in giving a few facts, but in getting the one being trained to think and so to develop.

Those who prefer to bring in outside men who are familiar with methods of foreman training feel that the very fact that the man is an outside man gives a new viewpoint which stimulates interest. Then too, they maintain that such a man, due to his experience with similar other groups, knows how to get the reactions that are wanted from the foremen. He must have a broad industrial background, but it is felt he does not need the intimate knowledge of the particular plant, as conditions in industrial plants are sufficiently alike to give a common ground so that he can guide along the proper lines. Care must be exercised, however, in using an outside man, that he does not advocate policies which, while correct in themselves, cannot for one reason or another be adopted in this particular plant. If such policies are advocated, the foremen knowing only one side of the question, the viewpoint given by the outside man, will very probably feel that the management is at fault, as they do not know the reasons why the management cannot or is not willing to adopt that particular policy. The management may not be in position to or it may feel the time is not ripe, but the foremen do not know this, nor is it always advisable to explain reasons why, as it puts the management on the defensive.

Method of Instructing Foremen.—The method of instruction is another point to which serious attention must be given. Each of the following methods has its advocates.

1. Lecture Plan.—Under this plan, lectures are given at stated intervals. Speakers either from within the organization or from out-

side are selected, due to their knowledge of the subject upon which the particular lecture is to be given. If the speakers are chosen with care, the foremen are given the opportunity of hearing from experts with whom they would probably never otherwise come in contact. In this way, they gain many valuable ideas and frequently an entirely different viewpoint on a subject. The very fact that the speaker is a well-known man in the field carries considerable weight. If the talks are mimeographed and copies distributed to the foremen, reading them again at their leisure recalls the talk to mind and deepens the impression made.

Two objections may be given to the lecture plan, however, first, the speaker is very likely to talk "over the heads" of his audience. The writer has in mind a lecture for foremen which he attended. The speaker, an authority in his field, talked so far over the heads of the foremen present that it was with difficulty that many of them, tired after their day's work, could force themselves to keep awake. The lecture, unfortunately coming near the beginning of the course, caused the attendance at subsequent lectures to drop to but a fraction of what it should have been. Another objection is that the pure lecture method does not bring out the ideas of the foremen. This can be overcome, however, if the speaker turns the latter part of the meeting into a discussion period, and he himself prepares for that discussion by raising questions in the minds of the foremen during the lecture. This is in contrast to those speakers who at the end of their talk pull out their watch, look at it hastily, and while still holding it in their hand abruptly use that set phrase, "Any questions that you would like to ask, I would be very glad to answer," then in the silence that follows sit down and the meeting is declared adjourned.

2. Conference Plan.—The conference plan advocated by the Federal Board for Vocational Education works out very well under an able leader, but is likely to fall short of success if the leader lacks ideas to bring forward and is not tactful and diplomatic in guiding. Under this plan, a group of foremen meet at regular intervals to discuss matters of common interest. To a considerable degree, success depends upon the personality and ability of the leader. He must be considerate of the feelings of others, he must understand human nature, and know how to handle the different types of personality he meets in the group. He should know how to bring forward the

foreman who has good ideas but cannot express them. He must know how to subdue tactfully the type of man who likes the limelight and would monopolize every meeting if given an opportunity. In addition, he must know the subject under discussion thoroughly. His value lies not only in imparting knowledge, but in developing men by getting them to think and discuss the problems that are presented.

The size of the group should be limited. Twenty is a very good number. It is large enough to have the discussion worthwhile and yet is not so large as to be unwieldly or that all cannot have an opportunity to contribute to the discussion.

3. Study Method.—Under the study method a special course may be prepared for the particular concern if the company is large enough to make the cost of such a plan worthwhile, or a course may be purchased from a commercial training school. A popular form of the latter are the correspondence courses for foremen. One thing should be borne in mind in regard to the study method. The average foreman has been out of school for a number of years and has gotten away from habits of study, therefore an assignment of sixty or seventy pages a week is a very difficult task and one which, with some of the men, may be the means of discouraging them to the point where they feel the training is quite beyond their ability. A reasonable assignment is of value as it prepares the minds of the men for the discussion and gives unity of thought, but it must be well selected and of a readable approach. With some of the services available, a trained teacher is furnished as the instructor or leader.

4. Letter-Conference Plan.—Under this method commercial organizations furnish weekly letters dealing with subjects of interest to foremen. Meetings are then held at stated intervals to discuss the contents of the letters, the letters being received by the foremen sufficiently in advance of the meeting to give them time to consider the subject matter and to prepare questions they may wish answered.

Time and Place of Foremen's Meeting.—When the courses are given under the auspices of the company they are usually held in the company building. When they are conducted by an outside agency such as the Chamber of Commerce, Manufacturers' Association, Y. M. C. A., etc., they are ordinarily held in the building of the agency.

There is always discussion as to whether foremen training should be on company time or on the men's time. Where the company requires attendance training should be conducted on company time.

Training on the foremen's time is never compulsory. It is easier to see who are truly interested when the man must give his time if he wishes training. Unfortunately, those that need training the most are those who will not seek it, even if the company pays all costs and so makes it easy for them. Another disadvantage is that if the men must go home from work for their dinner and then return for training, they are very likely to be too tired to get full benefit. Some concerns overcome this by providing dinner before the meeting. This serves to rest the men and to promote good fellowship among them and they are in a more receptive state of mind.

Cooperative Foremanship Training.—Where it is not practical for a company to conduct foremen training alone, good results are secured by grouping foremen from several plants, each plant bearing its share of expense in proportion to the number of its foremen receiving training. In regard to content of course, selection of instructors or leaders and method of instruction, the same points as brought out under the discussion of single plant training hold true with certain adaptations. For example, the content may have to be more general in character so as to fit conditions of the several plants. On the whole, the procedure is the same and the plan has worked very well for concerns of medium or small size that could not support a program of training by themselves. The foremen of such plants gain not only from the training given, but also from the contact with other foremen. A foreman in a plant employing but a half-dozen foremen or less is very likely to get into a rut and become very narrow in his views unless he is brought in contact with others.

Community Foremanship Training.—Some progressive communities have established a centralized foremanship program for all industries in that community. Notable among these is the foremanship training program in Flint, Michigan, where over 2,000 foremen were given training in the five years from 1922 to 1927. The superintendent of the night force of the Chevrolet Motor plant located at Flint stated that never in his eight or nine years' experience as a division superintendent of the Chevrolet Motor Company had he ever known a time when the company had such an efficient, loyal, coopera-

tive group of foremen as they have today.[5] All of these men, with two or three exceptions, were machine operators a few years ago. Every one of them had been through the foremanship training program.

The theory underlying the establishment of a community foremanship program is that of securing the best available training through combined effort. In addition, the training attracts ambitious workers from less progressive communities, as the worker feels that a community that offers such training is a good place to work and live.

Two points should be emphasized in regard to the community training, namely,

1. *Unusual care must be given to the selection of the instructor or leader.* He must be,

(a) A well-trained teacher.

(b) Unusually broad in his knowledge. While many of the topics in any foremanship course are equally applicable to the work of the foreman in an automobile manufacturing plant, a machine shop, a furniture factory, or a textile mill, the leader, in order to prove this fact to the satisfaction of the foremen, may have to give illustrations of the application of the principle in question from the work of each of the various industries represented.

(c) Skilled in the handling of men. All the qualifications mentioned earlier in the chapter as essential for the instructor or leader are intensified for the leader of a community training group. With mixed membership the problem of leadership is greater than in the case where the members of a group are all from one plant and know one another.

2. *Close cooperation* should exist at all times between the management of the various industries and those in charge of the training program. This is especially important in regard to,

(a) The content of the course. The content of the course should be such as to fit as nearly as possible the needs of the various industries in the community. In a community, for example, that has had considerable labor troubles, emphasis should be laid on principles of leadership, management of men, various phases of industrial

[5] Reducing Production Costs Through Training Old and New Workers. American Management Association, 1927. Production Executive Series No. 53, page 12.

relations work, etc., care being used, however, not to advocate any policies with which the management is not in accord.

(b) Special problems that may come up in any one of the plants. Where there is true cooperation between the management of the industrial plants and those in charge of the training program, the training leaders can do much to help solve or do away with problems by considering in the discussion what is apparently a hypothetical case, but which in reality is merely the actual problem skilfully camouflaged. Taking a problem in the abstract and getting the opinion of others not affected by the case frequently puts another light on the subject.

Cooperation With Educational Institutions.—In order that foremen will take advantage of opportunities for foreman training in the educational department of the Y. M. C. A., and in the night courses offered by nearby educational institutions, some concerns offer to reimburse employees who undertake such work, for the expenses they may incur. To guard against the employee registering and then only attending a small number of meetings, some concerns have the ruling that the employee will not be reimbursed unless he attends a specified number of meetings.

Federal and State Sources of Instruction.—The following extracts quoted from a booklet on foremanship by the Department of Manufacture, Chamber of Commerce of the United States, state briefly the federal and state aid that is being given in the training of foremen. The booklet dealing with the fundamentals in the development of industrial foremen gives full information as to the states equipped to furnish direct foreman training and instruction in foremanship and to whom to write.

All of the states have taken advantage of the distribution of federal funds under the Smith-Hughes Act passed by Congress in 1917 where, for every dollar spent (by the Federal Government), the state, local community, or both, shall expend an equal amount. This law is administered by the Federal Board for Vocational Education appointed by the President of the United States.

In many of the states, specialists in industrial education and foremanship are available for direct foreman training, and in others, only for foreman teacher-training. The latter is the training of foremen and

others by the specialists to become leaders and instructors of foremen classes and groups.

Direct foreman training by the Federal Board is conducted by the conference plan and is characterized by the entire absence of lectures. A definite subject for discussion is selected for each conference, and the series of conference subjects constitutes a coordinated and progressive program.

Some of these conferences are conducted intensively and daily over a period of two weeks, and in some instances they are extended over considerably longer periods.

A representative topical program as used by a representative of the Federal Board is: 1. The Foreman's Job; 2. Consideration of Foreman's Responsibilities; 3. Orders—Directions—Suggestions; 4. Continuation of Topic—Orders, Leadership; 5. Middle Ground; 6. Effects of Good Leadership; 7. Effects of Good Leadership (continued), Interest Factors; 8. Interest Factors (continued); 9. Interest Factors (continued), Cooperation; 10. Dissatisfaction, Breaking in Green Help.

While the programs in the various states where direct foreman training is available may vary to some extent—depending upon local conditions—the above topics are typical and the general plans of operation are necessarily similar to that recommended and used by the Federal Board for Vocational Education. This work is supported by public funds and, therefore, there is no charge attached.

A few of the states through University Extension Departments usually under the state universities, offer instruction in foremanship either by class or by correspondence. Typical topics are Handling Men, Industrial Goodwill, Employment Management, Selecting Men for Jobs, Planning Industrial Activities, Keeping the Quality High, Breaking in the New Man, A Safe Place to Work, Wage Problems, Advantages of Increased Production, etc. While generally under public auspices, there is usually a nominal charge made to pay for cost of material, etc.

CHAPTER XX

INDUSTRIAL RELATIONS DIVISION (Continued)

WORKING CONDITIONS—SERVICE TO EMPLOYEES—JOINT RELATIONS

Working Conditions.—In considering the subject of working conditions, service to employees and joint relations, as in all forms of personnel work, one must bear constantly in mind that personnel work cannot stand alone. The industrial relations division, in conjunction with the management, formulates personnel policies and develops ways and means of fostering cooperation and goodwill between the company and its workers, but it is with the line executives and supervisors in their everyday relations with the workers that the final responsibility rests. The industrial relations division, for example, may institute a splendid safety program, giving talks on accident prevention, placing posters on the bulletin boards of a type that would attract the eye of the worker and then give him pertinent facts regarding accident prevention, supplying goggles and other equipment for the use of workers, etc., but it is up to each foreman to see that the men in his shop use the goggles provided, that the shop is kept free from litter that would contribute to accidents, that guards and safety devices are used on machines where necessary to protect the worker, etc. If a foreman has a worker who is habitually careless or reckless and disregards rules and regulations established for his safety and that of his fellow workers, it is the duty of the foreman to talk with him on that subject and to make him realize how he is foolishly and unnecessarily exposing himself to hazards which may endanger his life or limb, and maybe that of a fellow worker.

The foreman who is truly interested in safety work and practices it himself can, with a little effort, instil in the minds of his men this same spirit of safety. Safety devices are an excellent thing in their way, but all the safety devices in the world cannot protect the worker who is habitually careless and reckless. It is up to the foreman to try to educate such a worker in the matter of safety, and if after

several warnings he still disregards the common rules of safety, to dismiss him from the shop as a valuable lesson to himself and as a protection to the company and his fellow workers. Such a lesson may be just the thing the man needs to wake him up to his own folly, and at the same time it removes a bad example from in front of other men. The spirit of carelessness and foolhardiness is contagious to others, just as is the valuable spirit of safety and caution. It is the duty of the foreman to see that the proper spirit is fostered. Similarly, in all other phases of personnel work the line executives and supervisors must do their part, for personnel work cannot be effective if it stands alone.

Few concerns could afford to have or would need to undertake all the various kinds of personnel activities covered in this chapter. They are given not as a program of personnel activities, each item of which is essential to the well-being of a company, but as an indication of sincere efforts being made by various companies in the interest of their employees. Some concerns may use only one form; other concerns, to meet their needs, may have quite an extensive personnel program incorporating a number of the activities given.

Safety Work.—The National Safety Council estimated that in 1926 industrial deaths totaled 24,000 and industrial accidents necessitating loss of time beyond the day of injury, they estimated at 3,000,000. Such figures are appalling both from a humanitarian standpoint and from the standpoint of the loss to industry. Much of the subject matter of the following discussion of safety work is adapted from or based upon material and cuts supplied by the National Safety Council, a non-profit, non-partisan organization which has given notable service in accident prevention and the making of industrial plants safer and better places to work.

The National Safety Council gives the eight following steps which should be taken to insure success in safety work, as learned from the twelve years' experience of the nearly 5,000 members of the Council. These steps are:

1. Appointment of safety director.
2. Analysis of accident records.
3. Meeting of operating executives.
4. Plant inspection.
5. Mechanical safeguarding.

6. General announcement.
7. Educational program.
8. Engineering revision.

Each of the eight steps will be taken up in order and discussed briefly.

The Safety Director.—One man should direct the safety work in every plant regardless of its size. This is another example of the application of the principle of centralized executive control in order to have authority and responsibility definitely fixed.

The larger the industry the greater is the need for a safety director trained in the personal and technical problems of accident prevention. In a smaller plant this man may have other duties also. His duties may be to:

1. Investigate all accidents and near accidents.
2. Keep accident records, make analysis of accidents and prepare special reports.
3. Confer with superintendents, foremen and workmen; assist them in designing guards and in eliminating unsafe practices.
4. Keep a record of all recommendations and of their final disposition.
5. Acknowledge and record all suggestions by workmen.
6. Assist the employment section and advise in instructing new men in safety rules and general shop practices.
7. Supervise safety bulletin board service.
8. Make regular inspections of the plant, including cranes, elevators, chains, etc. Also inspections for fire conditions and equipment and keep written records of all such inspections.
9. Visit other plants and attend safety conferences, and in other ways gather ideas and information with which interest in accident prevention can be stimulated and general plant conditions improved.
10. Check plans and specifications for all new equipment for safety before it is purchased and installed.

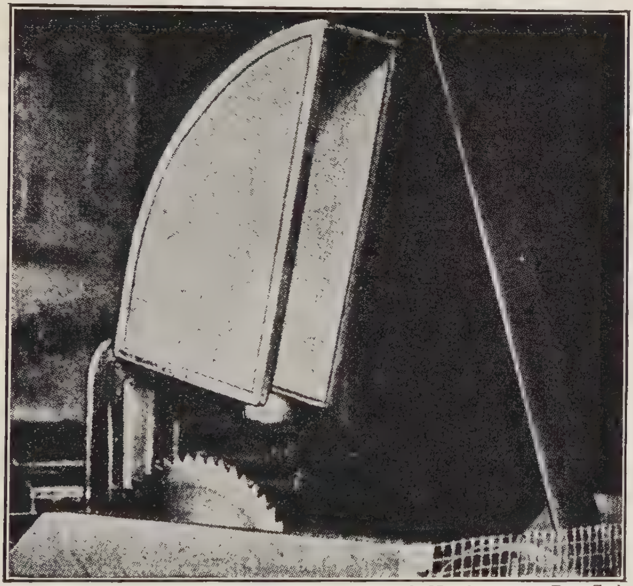
Analysis of Accident Records.—An analysis of all accident records should be made for several years past. This is essential for

determining the real causes of accidents, so that preventive measures can be prescribed. Such an analysis invariably shows that the majority of accidents result from carelessness or ignorance. Mechanical safeguards are helpful but they are not sufficient in themselves. The employees must be encouraged to think and work safely. An analysis of accidents gives those in charge of safety work concrete evidence to prove where the fault lies. This evidence can then be used in convincing the foremen and workers of the need for their cooperation if accidents are to be prevented. Several specific cases of accidents due to carelessness, involving some of the plant's own men, bring the question of safety directly home to the worker and are of more value in teaching safety than are any amount of generalities or the citing of cases in which those involved were strangers. Analysis likewise shows which departments or shops are responsible for the greatest percentage of accidents, and a friendly rivalry can be encouraged between shops to keep down the number of accidents. Likewise, if the analysis shows that the same person has had several accidents, it may indicate that the man is not fitted for the work he is doing. To the management, the analysis shows the loss in dollars and cents to them. The medical expense, lost time, labor turnover perhaps, additional rate paid for insurance if an appreciable increase occurs in number of accidents, etc.

Meeting of Operating Executives.—Before a safety program is put into effect, a meeting should be called of the operating executives and particularly the foremen. At this meeting the works manager, or some other one of the higher executives should outline the accident prevention plan, introduce the one to be in charge of the program and outline his duties, emphasizing the support that the management is giving him. Data compiled from the analysis of accident records should be given the operating executives, pointing out by means of specific cases the losses to the worker and to the company. The benefits of safety work as secured in other concerns should be also cited. The part that the operating executives are to play in carrying out the safety program should then be outlined and endeavor made to arouse enthusiasm, impressing on them the fact that success of the safety effort depends upon their leadership and good example.

Plant Inspection.—Following the meeting the safety director should make a complete inspection of the plant, accompanied in each

shop by the foreman of that shop. In this intimate contact with the foremen the head of the safety program, if tactful and diplomatic, can win the sincere cooperation of the foremen. Together they should check all dangers that need to be safeguarded and work out the guarding program. The foreman from his everyday close contact with his shop and its equipment knows its points of danger; the man in charge of safety work can point out preventive measures.



(Courtesy of Chicago & Northwestern Ry. Co.)

Figure 61

A man who had worked at this machine for many weeks decided he could do quicker and faster work by discarding the safety guard. So he lifted it up out of the way as shown in this picture. His hand was caught the very first time he tried to take a log out of the machine with the guard swung up and he lost his hand. Fifty thousand men were injured in exactly similar way when they decided they could work better without guards.

In some cases, the foreman may not even realize his men are being injured. If the work of some of his men calls for lifting unusually heavy objects, the foreman may be so used to having the men do it that he does not realize it may be injurious to them. Just because they always have done it, he thinks that it is all right for them to continue to do so. He may never have considered that the reason they had accidents was due to the extreme effort the men had to put forth.

He may never have reasoned why he had high labor turnover on those jobs. If, however, the man in charge of safety suggests a mechanical hoist, the foreman would readily see the value of the suggestion and would be only too willing to have it installed.

Mechanical Safeguarding.—Hand-rails and guards for gears, belts, pulleys, etc., should be installed in accordance with the specifications of the state or insurance company standards. Such mechanical safeguarding impresses upon the workmen the fact that the company is sincere in promoting safety and willing to do its part, and at the same time they eliminate the majority of accident hazards within the direct control of the company.

General Announcement.—At a general mass meeting or at meetings in the several shops, the plan for accident prevention should be outlined to the workers and efforts made to arouse their enthusiasm and cooperation.

Educational Program.—The educational program is not restricted to the workers but includes the keeping up of interest on the part of the management through reports of safety work accomplished, meetings which some of the executives attend, etc., and the encouragement of and the giving of advice on safety matters to the foremen. Some concerns have foremen's safety committees to make special safety inspections and accident investigations and to pass upon the plans and activities of the safety director. Others send to all foremen monthly letters on safety or copies of National Safety News giving safety ideas. Interdepartment safety contests are another means which have proved very satisfactory.

For the workers, education is the only practical means of bringing the individual worker to a realization of what an accident would mean to himself and his family. This education must be continuous, constructive and interesting. The writer doubts very much that any real success in accident prevention can be expected from issuing a long list of don'ts. A list of 40 or 50 don'ts on the bulletin board may be impressive to the one who compiles the list, but how many workers would bother to read them, and if they did how many would they remember when they got to the bottom of the list. A few constructive ideas would carry more weight. Workers are not children, and they

do not want to be treated as children, moreover, even with children the don't idea is carried entirely too far.

Many ideas have been developed for the education of workers. Some of the more common include:

1. *Use of safety posters.* The National Safety Council, appreciating the fact that pictures are more powerful than words, publishes 40 two-color posters every month, from which members may make their selection and requisition their supply for the ensuing month. In this way posters may be changed often and interest of workers kept up. Posters properly displayed are an effective means of education. They should be hung where men see them going to and from their work and in other appropriate places. An effective location for a bulletin board is at a sanitary drinking fountain, where the posters cannot help but catch the eyes of the workers.

2. *Publication of plant magazine with considerable space devoted to safety.* The Midvale Safety Bulletin, published by the Midvale Company in the interest of its employees, is a splendid example of what can be done in presenting safety information. The magazine is written in a most readable style so that the interest of the reader is held. Bits of humor, incidents in the shop, information of interest regarding fellow workers, all add to the popularity of the magazine with the workers and yet the main topic, that of safety, always predominates.

For example, in the issue of August, 1926, a list of alibis for not wearing goggles was printed and suggestions given to overcome each objection that had been raised. At the close of the suggestions cases were cited where goggles saved the eyesight of workers. One the case of a man who had his face severely burned with molten metal but his eyes were saved by the goggles he had on; another case, that of a man who had worn goggles constantly for two years and the first time he attempted to work without them he lost his left eye. The article closed with the following paragraph, "A workman owes it to his family to keep himself fit so that he can earn the maximum wage for their support, and if he fails to take advantage of every known protection, he is failing in his duty to that family. He should, therefore, wear protective devices to protect his family." [1]

3. *Special safety instruction to new employees,* to acquaint them

[1] The above article was an extract from a paper delivered to the Metal Manufacturers' Association on February 18, by E. S. Chapin, Supervisor Inspector, Philadelphia District, Department of Labor and Industry.

with the use of the protective devices provided for them by the company and to interest them generally in safety.

4. *Classes in safety and first aid.* Every endeavor should be made to prevent accidents to employees, but in case they do occur, provision should be made for prompt attention and skilful care of men injured. Many industrial concerns have first-aid crews who have received special training under the company doctors. In the United States Steel Corporation, 21,731 employees have received instruction in first aid and rescue work, and 396 are now in training. Fifty-eight training stations are maintained for this purpose.[2]

5. *Motion pictures and stereopticon slides.* The National Safety Council maintains available for its members a complete and up-to-date collection of lantern slides and moving picture films dealing with accident prevention problems.

6. *Interplant or interdepartment contests.* The Mansfield Sheet and Tin Plate Company adopted as an incentive a horse-race plan.

The various divisions were combined into 7 groups of approximately equal numbers of men. Small, cast-iron, mounted jockeys were lined up along parallel grooves in a wooden base. The base was marked off to indicate days of the month. The jackets of the jockeys were painted different colors; these colors were assigned to the various groups of departments and a notation put on the board showing the assignments. The board was enclosed in a frame with a glass front and put up near the entrance gate. For each day that a group had no accident, the corresponding jockey was moved ahead one mark. The race, of course, might end in a tie, but the loss of one mark through an accident was a bad handicap to winning, and was guarded against by extra precautions for safety.[3]

7. *Workmen's safety committees.* Each company of the United States Steel Corporation has a Central Safety Committee made up of representatives from its various plants, and in addition each plant has plant workmen's safety committees, consisting of members from the rank and file of the mill and plant departments and special committees composed of foremen, master mechanics, and skilled workmen who study and investigate problems relating to the safety of the employees. In 1925 the number of serious accidents per 100 men employed in the United States Steel Corporation was 60.22%

[2] United States Steel Corporation Bulletin No. 11, 1926.

[3] Samuel Davey, "Cutting Lost Time Accidents 69 Per Cent," *Manufacturing Industries,* October, 1927.

Junior class sec.
Capt. mil.
Football

Senior garb. c
school social
comm.

less than in 1906 when these activities were started, and disabling accidents were 80.07% less than in 1912. This means when stated in round figures that 46,863 men have been saved from serious injury and 322,408 men have been saved from any injury which resulted in a loss of time.[4] No doubt the plant workmen's safety committees have played a considerable part in bringing about this truly wonderful achievement in accident prevention. In some of the companies there are "no accident" clubs in which only those employees are eligible for membership who have had no accidents for five years.

8. *Special campaigns such as "No Accident Week."* In the May and June, 1926 "No Accident" drive of the Midvale Steel Company, first prizes were awarded to each individual superintendent, foreman and workman in the following departments—forge department, rolling mill, tire mill and yard, and second prize to the treatment department which had one accident during the two months.

In the Pullman's second annual May drive only two minor accidents were suffered among the 26,000 miscellaneous employees of machine shops, railroad yards, and rolling stock scattered from Maine to California. This remarkable record shows what can be accomplished in safety work when the whole working force is interested.

Engineering Revision.—

This means the improvement or redesign of machinery, equipment and processes, so as not merely to cover up hazards but to eliminate them and at the same time to increase efficiency and production. This engineering phase of safety is often neglected, but it can well be made a major activity that will pay unusually large returns on all of the time and effort that may be invested.

Safeguards are usually but temporary expedients awaiting the development of more fundamental means of eliminating accident hazards.

For instance, several years ago numerous gates and guards were installed on power presses to sweep away the operator's hand when the ram descended. These safeguards have now become more or less obsolete because of the development of mechanical methods of feeding. These feeding devices make it difficult and in most cases impossible for the operator to get his hand into the danger zone.

One of the companies that pioneered in engineering revision as applied to power presses, has practically eliminated all power press accidents, whereas they used to cut off an average of thirty-six fingers a year. Not

[4] United States Steel Corporation, Bulletin No. 11. Bureau of Safety, Sanitation and Welfare.

only that, but the production of these presses has been increased 60 per cent.

What has been accomplished in this particular operation can and should be accomplished in many other industrial operations.[5]

Safety Work Pays.—Calculations show that had accidents continued in the United States Steel Corporation at the rate they were in 1906 when their safety, sanitation and welfare campaign was inaugurated, the Corporation, under various state compensation laws would have paid to those who would have been injured or to their families, a sum far exceeding the amount spent in preventing accidents. In ten years the Corporation spent $9,763,063 in accident prevention work, and the money saving resulting therefore is calculated at $14,609,920 in addition to the fact that 250,000 men have been saved from injury and probably more than 40,000 have been saved from fatal injury. As the United States Steel Corporation is a self-insurer it is in a position to know the actual money gain to be derived from intelligent accident prevention work. The above figures demonstrate that accident prevention work pays in dollars and cents.

Safety work, therefore, should appeal to the management of every industrial concern, large and small, for to those who do not recognize the humanity appeal, there is the appeal of a good business proposition, an actual saving in money.

Sanitary Conditions.—Unsanitary shop conditions are reflected in the attitude of the worker and in the lowered morale of the entire force. If floors are dirty, workers are very likely to get careless and spit on the floor. The sputum drying and mixing with the dust is likely to be inhaled by the workers. Such a condition should not be permitted to exist. Floors should be cleaned regularly after working hours, cuspidors or sawdust boxes should be provided and their use insisted upon. A clean, orderly shop promotes pride in the shop and good workmanship on the part of the worker. Any shop can be kept clean. It costs no more and requires no more effort to pick up litter than it does to walk around it. A "clean-up" week occasionally pays. Once a shop is in good order it requires very little effort to keep it that way, provided every worker does his part. An incentive to the workers, such as a prize for the cleanest shop with a picture of the winning shop in the company paper, invariably has good effect.

[5] An Industrial Safety Program to Fit Your Needs—National Safety Council.

Where work is dirty, men should have quarters provided with lockers and showers or washing faucets. They can then wash and change their clothes before going home. If the nature of the work is such that the working clothes get unusually dirty, a double locker arrangement is convenient, for then the worker's street clothes will not have to be hung where the dirty working clothes have been. Some companies instead of having lockers have an overhead hanging

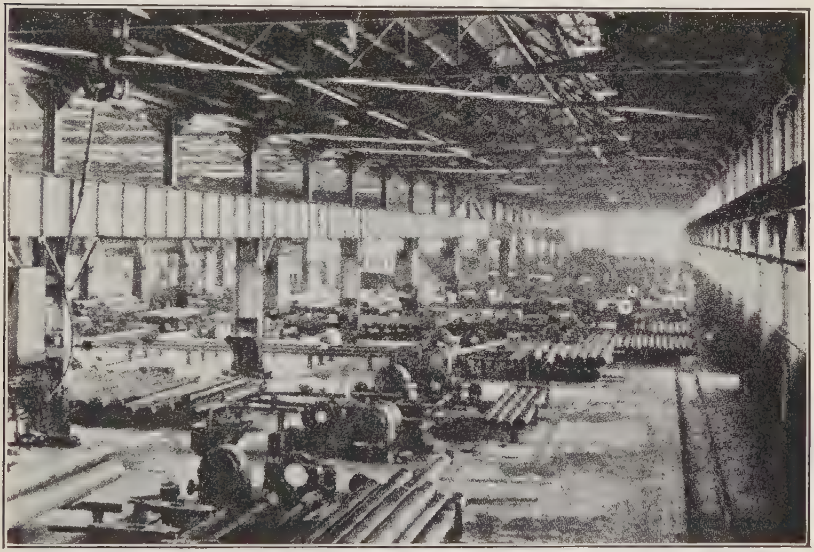


Figure 62. Lap-Weld Pipe Mill, Showing Good Safety Conditions (Gary Tube Company, Gary, Ind.)

arrangement. Clothing is hoisted overhead by means of a rope and pulley into an open receptacle and there locked into position by the user. Clothing of one person does not come in contact with that of another person. Such an arrangement works particularly well in those cases where the clothing of the workers becomes damp. The clothing being hung overhead permits of thorough ventilation and drying while the men are off duty. Facilities for washing always should be so arranged that the men must use the flowing stream.

Toilet facilities should be adequate and located where they will be convenient to the workers.

A supply of pure, wholesome drinking water is an absolute essential. Water should be analyzed periodically, and every care should be taken to prevent pollution. Bubbling fountains with water at the correct drinking temperature are the most sanitary arrangement. By such sanitary methods as above described, the standard of the physical conditions in the plant is raised and occupational diseases and ordinary illnesses among the worker greatly lessened.

The subjects of industrial lighting, heating, ventilating and humidity, and the effect of proper and improper conditions in this respect upon the workers, were covered in Chapter VII.

Medical Service and Health Supervision.—Under the discussion of employment mention was made of the physical examination given to an applicant after the interviewer considers the applicant otherwise qualified. The reasons for such an examination are to ascertain the general physical condition of the applicant, to see whether he is physically fitted to do the work of the job for which he is applying and to prevent contagious diseases being introduced into the plant. In the examination, particular attention is given to any special physical conditions which might interfere with the worker in the particular job. For example, if the job necessitated much lifting, it would be out of the question to employ a man that the physical examination showed had hernia. Similarly, if the job called for assembly of very small parts, special attention would be given to vision—the applicant with defective or poor eyesight being not considered as physically qualified for that particular job. In addition to this entrance physical examination, some concerns have reexaminations, particularly for those workers exposed to occupational hazards, the frequency of examinations depending upon the class of work performed. Records of all examinations are kept. These are important in case of question of transfer of the employee to another job and of claims for compensation for disabilities. Where the record shows that the worker was disabled in that respect at the time of employment and that the worker knew of such disability and made a written statement to that effect, the record is a protection to the company against unjust claims.

The practice is spreading of having a dispensary to which the employees are urged to go in case of all injuries no matter how trivial, and of illnesses coming on while at work. In a very large

plant several first-aid rooms should be located at suitable places, so as to be convenient to the workers they serve. Many workers would be glad to go to a convenient first-aid room in the charge of a well-trained nurse when they would not take the time to go to the main dispensary. The test of the value of industrial medical service is not in the reputation of the doctor in charge or in the cost of the equipment available, but in whether the service is used, and the benefits derived therefrom.

Doctor and Nurses.—Much of the success or failure of a medical and health supervision service lies with the doctor and nurses in charge. Both should be selected from the standpoint of personality as well as training. They should be courteous, cheerful and sympathetic, so that the workers will come to them willingly, will talk freely and openly to them, and will follow advice given. Where the amount of work does not warrant a full-time physician, part-time arrangements can be made.

It is generally agreed that 25% of factory workers have bad teeth. As bad teeth affect health and productivity, some of the larger plants provide a well-equipped dentist's office where work is either done free or at cost. Similarly, other concerns have established ocular clinics in the charge of a full or part-time oculist, as the volume of work demands. Examinations and ordinary corrections are made at the clinic, with the glasses secured from an outside firm under a special arrangement which lowers the cost the employee would ordinarily have to pay. As defective vision reduces productivity and increases spoilage of work and probability of accident, this is one more of the many forms of personnel work that pay for themselves in dollars and cents to the company. Other valuable industrial medical work is done in regard to the nose and throat. As 40% of the sickness among industrial workers is attributed to diseases of the respiratory system, anything which will combat this situation proves beneficial to both employer and employee.

Medical service and health supervision should be, primarily, preventive and, secondarily, corrective and curative. As a means of fostering interest in good health work, a program of health education should be adopted in order to bring the workers to a realization of the necessity for good health habits and to secure their cooperation and that of the foremen. A foreman who is awake to the possibilities

of preventive health work is alert to the worker who shows early signs of fatigue and overexertion or other indications that he is not physically up to par. Having the plant doctor examine the worker and advise him what to do greatly increases the worker's chances for speedy recovery of his usual good health. Immediate attention may also result in preventing an epidemic among workers who would otherwise be exposed.

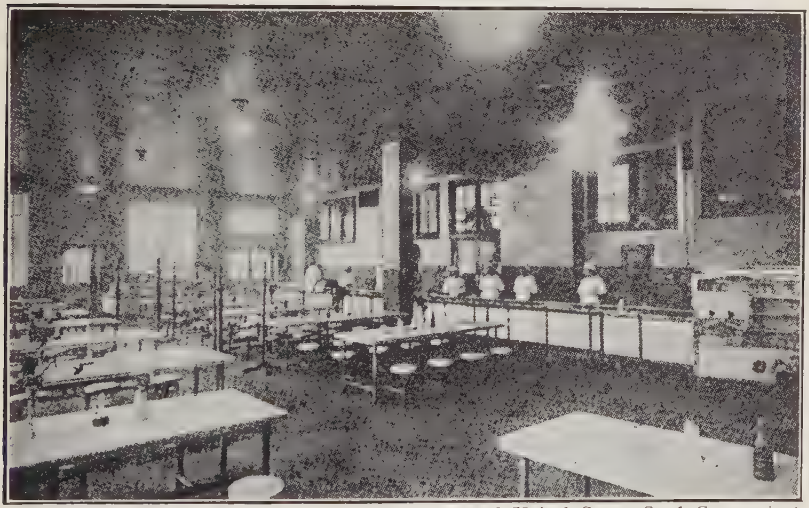
Plant Hospital.—Where the working force in a plant is large enough to require it, or where the plant is located at considerable distance from a hospital, it is advisable to maintain a well-equipped hospital for the use of the employees. Other concerns, not having the necessity for maintaining a hospital of their own, endow beds in local institutions. The subsidiary companies of the United States Steel Corporation maintain 383 completely equipped emergency hospitals. No matter how trivial the injury, all injured employees are sent to the emergency hospitals where they receive prompt attention. This tends to eliminate the chance of infection, the one greatest single cause of disability from accident. If the injury proves to be of a serious nature, the employee is immediately transferred to the nearest hospital for further treatment. Eleven base hospitals are operated by the subsidiary companies at various locations to provide proper facilities for the treatment of serious cases; but as a rule, where the plants or operations are situated near populous centers, the injured employees are sent to public hospitals. The benefit to the injured employee of such prompt and efficient treatment can hardly be overestimated.

Plant Lunchrooms and Cafeterias.—A properly fed employee is a more efficient worker. Realizing this fact, many concerns maintain plant lunchrooms or cafeterias where the employees can secure well-cooked, nourishing food either free or at cost. Ordinarily, the cafeteria style is preferred as they are cheaper to operate than are the lunchroom or restaurant style. They conserve time, as more persons can be served in the same length of time with fewer attendants. In addition, workers prefer them as they can see what is on the menu for the day and can make their selection knowing just what they will get.

The plant lunchroom or cafeteria is sometimes run by the plant

itself and sometimes let by contract. In the latter case it is essential that close supervision be exercised so as to insure that the workers get at a reasonable cost the quality and quantity of food the management intends them to have.

Maintaining a plant lunchroom does away with the necessity of the employee having to bring a cold lunch from home. The lunch no matter how carefully put up early that morning or the night before is frequently anything but inviting and appetizing when the time comes to eat it. In addition, the use of a lunchroom helps to



(Courtesy of United States Steel Corporation)

Figure 63. The Plant Restaurant. Here employees can obtain warm, wholesome meals at moderate cost

keep the plant in a more sanitary condition than it would be if the workers were to bring their lunch from home and eat it in the workroom. If an employee for any reason prefers to bring a lunch from home, he should have the privilege of eating it in the lunchroom with the other employees. Eating together in a pleasant room furnished simply but comfortably stimulates good fellowship on the part of the employees and serves as a little relaxation and simple recreation. It is a pleasant change from the steady, monotonous grind, and it brings the worker back to his machine or workplace refreshed in body and mind and in condition to do a fair day's work.

Some concerns provide, in addition to the regular menu served in the lunchrooms, box lunches for those who do not care to go to the lunchroom. The box lunch with milk or coffee which can be bought for a few additional cents serves as a fair sort of lunch, although not as desirable as the hot lunch served in the lunchroom.

Some concerns, in order to stave off fatigue and to give health and strength to their employees, are encouraging the use of milk by having a short rest period in the middle of the morning and the middle of the afternoon at which time the employees may have a bottle of milk served to them at cost. Many workmen come to work without a suitable breakfast. By nine or half past nine they feel hungry and are likely to snatch a bite of lunch when they think their foreman is not looking. Such hurriedly eaten food does little real good to the worker and the fact that he is breaking a company rule by eating during working hours lowers plant morale. To set aside a ten or fifteen minute period gives the worker a chance to rest and to drink a bottle of fresh milk. This satisfies the worker's hunger, as milk is practically a perfect food. In addition, it does away with the chance of any underhand actions on his part and so fosters plant morale. The rest period, while it takes time out from the employees' working day, increases productivity, as the refreshed worker attacks his work with vim, while the fatigued or hungry worker works with the one idea of waiting for the whistle to blow so that he can stop work.

Recreation.—The management can build up plant morale by intelligent planning and promotion of wholesome recreational activities. Mr. Charles Platt, president of the National Probation Association, states that organized play is the best preventive that has ever been discovered for juvenile wrong-doing. Does not the same thought at least to some extent apply to grown up men and women? Everyone should have an opportunity for wholesome recreation. If the desires of employees are directed into channels where their leisure time will be spent in pleasant, healthful recreation, they will not be such easy prey for the agitator. The worker who listens to the corner demagogue and becomes imbued with his false doctrines is the man with time to kill. Give that same workman an opportunity for companionship of wholesome men of his own class and a little pleasant social life, and he would ignore the demagogue. He would not

have time to spend in listening to corner orators painting for him fancied wrongs.

The average worker spends a good portion of his working day indoors. Anything that will encourage him to go out in the open and enjoy a little active outdoor life builds him physically and in every way. Interdepartmental athletic competitions give an added zest and develop a good wholesome rivalry. Teamwork is fostered. That in itself makes athletics very worth while, for teamwork is the backbone of business just as it is in football or baseball.

Employees' Club.—In order to promote wholesome athletics and social events, some concerns bear all expenses involved and a few even go so far as to build club houses. Quite a usual plan is for the management to sponsor a company club, all employees being eligible. Dues are kept nominal and the company agrees to pay to the treasurer of the club an amount equal to the amount paid in by the employees provided the amount paid in shall not exceed a specified sum. In this way the company lends its support but not to such an extent but that the employees feel the club is their own. In company support of recreational activities, care must be exercised that the management does not interfere with the active management of club affairs. In so far as possible the club should be managed solely by the workers themselves. One of the greatest values of employee activities is the practice given for self-government. By encouraging as many employees as possible to take active part in club affairs, latent talent for leadership is discovered and fostered.

Recreational activities need not be restricted to outdoor sports, but can include various forms of indoor recreations—basketball, bowling, swimming, handball, in the athletic line, and music, singing, bands, orchestras, dancing and entertainments. The extent to which recreational activities should be carried depends upon the local conditions.

Employees' Suggestion Systems.—Many employees have good ideas for increasing production or for improving plant conditions but they do not volunteer them. They feel "what's the use, I won't get anything for it," or else they are afraid that if they tell their ideas to their supervisor he will get the credit for it when he reports it instead of the worker receiving credit. As a means of awakening interest and to secure valuable ideas from the workers, suggestion

systems are adopted. As in all personnel work, the first step is to sell the idea to the workers. The employees should be made to feel that the company values and wants their ideas and that they will be rewarded for all suggestions accepted. The point should be emphasized that the employee whom the company values most is the thinking employee and that the company can only know the employee's ideas when he brings them to the company's notice. An employee may have splendid ideas but if he keeps them to himself how is the company to know that he is any different from his fellow worker who plods along without thinking about his job and the plant.

So that the worker will know the kind of suggestions wanted and not indulge in generalities or develop ideas involving radical changes in the company's policy, an announcement should be made stating definitely the kinds of suggestions wanted as, for example, suggestions as to savings in labor, time and materials, suggestions for accident prevention, for increasing the sales of the product, general plant welfare, etc.

In most plants all employees are eligible with the exception of the supervisory force. The latter, as a part of their regular duties, are expected to work out new ideas, to develop new plans and to make improvements in methods, therefore they are not eligible for award unless their suggestions do not concern their own department.

A simple procedure should be devised for the submitting of suggestions so that all suggestions will be received in a uniform manner. A usual practice is to install small suggestion boxes similar to the ordinary ballot boxes at convenient locations throughout the plant. In an open box beside the suggestion box is placed a number of simple suggestion forms with space for the date, employee's name, and payroll badge number, and the suggestion he wishes to submit. In cases where it is desired to have the name of the employee secret until after the suggestion has been passed upon, the name of the employee is omitted and the suggestion blanks are numbered consecutively. Each suggestion blank is provided with a stub bearing the same number as the sheet. The one submitting the suggestion tears the stub off the form after he has written his suggestion and retains it to identify him, should his suggestion be accepted and award made.

Passing on Suggestions.—Ordinarily, the suggestions are passed upon by a committee which may or may not include representa-

tives of the employees. The committee studies each suggestion carefully. Where the adoption of a suggestion would influence the operation of a certain shop or department, before acceptance is given to the suggestion it is referred to the one in charge of that shop or department for his approval. Record should be kept of all suggestions and their disposition. Where the name of the employee making the suggestion is known, acknowledgment of the suggestion should be made immediately upon its receipt. Suggestions should be acted upon as promptly as conditions permit. When a suggestion is rejected the reason should be given to the employee submitting the suggestion. This serves to keep up his interest, to show him the committee is acting fairly and above board and to guide him in submitting other suggestions.

Practice differs as to how to reward employees for suggestions adopted. Most companies give monetary rewards and many endeavor to have the amount of the reward bear a definite relation to the value to the company of the suggestion. In many instances, however, it is difficult if not almost impossible to determine the value of the suggestion in dollars and cents. Generally speaking, it is probably better to try to interest the mass of workers by giving rewards for a large number of suggestions than it is to have a few large rewards. If there are only ten prizes ranging from $25 to $400 and 500 suggestions have been submitted, there will be many employees very disappointed and probably the majority of them will not offer a suggestion again. They may feel their suggestions were equally as good as those selected and in truth some of the suggestions rejected may have been very good, the difficulty being to select the ten best among so many. If the same amount of money had been divided among 125 prizes ranging from $5 to $100, many more would have had the pleasure and satisfaction of winning. The spirit of competition and the pride in achievement are to many almost as important if not more than the prize itself.

Some concerns, in addition to awarding a prize, reward those who show unusual ingenuity and interest by promotion to positions of greater responsibility and better wage.

To keep the interest in suggestions alive and to bring before the employees the names of those that have submitted valuable suggestions, the names of successful contestants are printed in the shop paper frequently with a brief discussion of the suggestion and the

photograph of the employee. The following notices of suggestion awards appeared in the Midvale Safety Bulletin of January, 1927.

SUGGESTION AWARD

T. A. Wallace (506-802) Awarded a prize of $30.00

Devised and put into use a certain special bushing that made it possible to utilize a large quantity of grinding wheels which had been carried in stores and charged off as useless and dead stock. Suggestion resulted in a considerable money saving for the Company.

James Cavanagh (Iron Foundry) Awarded a prize of $20.00

Designed and installed a jagger chill in Iron Foundry, with which it is possible to make 200 cast iron jaggers an hour. Under former method, it took a full day's work for a blacksmith and helper, using bar iron, to make a similar number. The new method effects a considerable saving of money.

In the August, 1927 issue of the same shop bulletin appeared the notice of an award of $20 to I. Bailey, foreman of riggers, for a safety harness for protection of men who have to enter tanks, sewers, furnace flues and other dangerous locations, as well as lowering injured men from aloft. The belt will hold an unconscious man erect so that he may be pulled through a manhole or other restricted place.

From the above three suggestion awards, which were only three selected for illustration at random from among many, note the variety of subjects covered and the breadth of interest on the part of the employees. To utilize dead stock, to speed up production, to prevent accidents and probably save lives, they are some of the valuable suggestions that can be secured from the workers. No stronger argument is needed to urge development of employee interest on the part of all industrial concerns.

Information and Rules.—So that there may be no misunderstanding about shop rules, pay, hours, opportunities for training, regulations in regard to vacations, absences, and so forth, some concerns give to each new employee a booklet containing helpful information as well as instruction. The Coleman Lamp Company, in its booklet "The Coleman Organization, Its Policies and Purposes," sets forth in simple language the threefold purpose of their booklet:

1. To serve as a means of acquainting new employees with the customs and policies of the organization.
2. To provide executives and clerks with a guide to uniform procedure in matters of relationship between employees and the company.
3. To serve as a reference book for all workers, to the end that there may be the fullest understanding of the duties and privileges we share as co-workers in industry.

Shop Paper.—A shop paper, or house organ as it is sometimes called, is a valuable means of fostering goodwill on the part of the employees. The employee carries his shop paper home with him where he can read it at his leisure. He is then away from the distracting influences and those little everyday annoying troubles in the shop. He is rested and in a better frame of mind to look at things in a broader light. Reading quietly at home he is better able to appreciate the views of the management as set forth in the shop paper. He begins to look at the plant as a whole and not from the narrow viewpoint of merely his own job, and he develops a spirit of pride in his company.

The shop paper serves as a means of educating the employees in a knowledge of the company and its products; of giving publicity to various company activities, such as suggestion systems, pension plans, profit-sharing, stock ownership, etc.; and in general, in getting information to the employees and of fostering their goodwill.

Stock Ownership.—Every company likes to encourage thrift in its workers, knowing the thrifty worker is the more stable worker, a happier and more contented individual, and a better citizen. In consequence, the practice is growing, especially among some of the very large concerns, of selling stock to their employees under advantageous terms. In order to make the plan attractive to the worker, a number of methods have been worked out. Some concerns make a concession in price at which stock is sold, others pay bonuses or extra dividends to employee stockholders, others contribute a certain percentage of the cost of the stock the employee buys, others permit payment of subscriptions by instalments deducted from the subscriber's wages, and so on. Under the plan of the Western Electric Company, any employee who has had at least six months' service with the company is eligible to purchase American Telephone and Tele-

graph Company stock on a salary deduction plan. The deductions amount to 75 cents a week or $3.00 a month per share. Each employee is allowed to purchase one share for each $300 of his annual salary. The company credits interest on these deductions at the rate of 7% compounded quarterly. More than 60% of the employees have taken advantage of the privilege and collectively are saving more than $10,000 a day under the plan.

The advantages attributed to stock ownership are many and varied. In general, it is believed that stock ownership reduces labor turnover, on the theory that as the stock-owning employee has a financial interest in the company, he is more interested in its welfare, is a more conscientious worker and is less likely to leave the employ of the company than is the employee who does not own stock. To the worker, the advantages are at once apparent of any plan that awakens a sense of thrift and makes saving easy. To the worker who is thrifty but who is doubtful of banks and ignorant of investments, the ownership of stock in the company for which he works opens up to him a source of income from savings. It makes an investor out of the hoarder and puts his savings into circulation. This is especially important among some of the classes of the foreign born.

Home Ownership.—Where the plant is located in a city or suburb, the company is not troubled by the problem of housing. Where plants are built at some distance from any city or large town, in order to attract and hold labor the company must make some provision for housing its employees. The problem is usually met by the company constructing houses which it either sells to its employees at cost or leases to them at low rental rates.

The advantage to anyone of home ownership is more than the saving of rent. The home owner has a more conservative point of view toward society in general. The development of the individual and the change of attitude toward industry and society is so well illustrated in a story told by A. B. Farquhar that the writer feels it can profitably be retold here.

I have found that the best antidote for acute economic insanity is ownership of property. My favorite example is Otto Steinerger. He was one of my first employees and what was rare in those times—a rip-roaring anarchist. He insisted that all wealth came from the workers and, therefore, should go back to the workers. He was particularly bitter against

his landlord and hardly a week went by that he did not announce that he had definitely decided that he would like to shoot the landlord the next time he came around for the rent. Finally I asked him smilingly after one of these outbursts:

"Why don't you buy your own house instead of shooting your landlord? Then you would not have to pay any rent. If you do shoot him you may get into trouble."

He did not think much of the idea apparently, but in a day or two he asked me how he could buy the house. I answered:

"That house can be bought for $800. You are getting good wages. I will buy that house for you, take $4 a week out of your wages, and in less than four years you will have it paid for."

He went off again. The next time he came back it was with his wife. He said:

"We are going to buy that house but since we have no children you can take $10 instead of $4 a week out of my pay envelope."

I bought the house and then Otto's chief concern was to get it paid for, which he did in a little more than a year. There was another house next door to him. In a short while after he had paid for his first house, he sidled up to me and said:

"I can buy that house next door for a thousand dollars. Now that we have no rent to pay we are going along good. What do you think about buying that?"

He bought that house and joined the hated landlord class. Some years later when it was reported that a band of strikers were advancing on York to shut all factories, Otto rushed into my office at the head of an excited group of men from the shop yelling:

"Get us a lot of shotguns and we'll keep those fellows out of here. Those damned fools expect a man to work and save and then walk in here and take what he has got without paying for it."

And that, I think, is always the way to develop a conservative.[6]

Thrift Plans.—The average person has little conception of the vast number of persons dependent upon relatives and charity when they reach the age of 65. Various thrift plans have been devised from time to time to get industrial workers into the habit of systematic saving so that they can enjoy greater comfort, security and independence in their old age. The two plans here briefly discussed are given as illustrations of what is being done by employers to stimulate saving on the part of their employees.

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[6] The First Million Is The Hardest, by A. B. Farquhar in collaboration with Samuel Crowther. Copyright, May 12, 1922, by Doubleday, Page and Company.

A simple but effective plan is that which has been in operation at the Crompton and Knowles Loom Works for the past eight years. During the World War, the Loom Works like many other industrial plants had a committee made up of shop employees, one of whose duties it was to sell Liberty Bonds to the employees. After the war some member of the committee suggested that now that the employees had become accustomed to save, it would be well to try to capitalize that fact and get them to continue their savings. This was accepted by the general manager and from it was evolved their present savings plan. The plan is exceedingly simple and merely involves the deduction from the employee's weekly wage of a certain amount agreed upon and depositing the same in one of the five savings banks of the city, the employee having previously specified the particular bank in which his money is to be deposited.[7] At no time has there been less than 60% of the employees participating, and now upwards of 85%. Three features appeal to the working force, simplicity, flexibility and safety:

1. *Simplicity.* Each week the savings deduction, as agreed upon with the employee, is made from the employee's pay and deposited in the savings bank before the employee receives his pay for the week, a slip being put in his envelope advising him of the fact and also stating the accumulated amount deposited to date.

2. *Flexibility.* (a) If a man wishes to increase his deposit, he simply tells his foreman, who advises the payroll office, and the change is accordingly made. If he wants to reduce the amount, the same simple rule is followed. (b) Deposits may be suspended temporarily in case of unforeseen demands upon the employee's wages. The same rule applies here as in the increasing or decreasing of deposits. (c) If a man wants to draw a little money out for an emergency he signs an order, the paymaster gives him the money, and he is not even obliged to go to the bank.

3. *Safety.* All accounts are deposited in the mutual savings banks of the city, whose operations are critically regulated by law. In this way the wage earner's money, so accumulated, is as safe as it can possibly be made.

Another Thrift Plan.—The other thrift plan to be described is the credit union. Many consider the credit union as something new, and therefore in the nature of an experiment. Credit unions, how-

[7] The plan was discussed by the vice-president and general manager, John F. Linsley, in a paper read before the annual convention of the American Management Association, March, 1926.

ever, have been in successful operation for more than seventy-five years in Europe, for twenty-five in Canada, and sixteen years in Massachusetts. The following discussion of the credit union is based upon and in places quoted from a paper presented by the executive secretary of the Credit Union National Extension Bureau: [8]

A credit union is a cooperative savings and loan association organized within a specific group of people. It accumulates the savings of these particular people and uses these savings exclusively for loans to these same people.

The credit union is a system which specializes in the saving capacity of the individual who is the least able to save. Even for the man who can only save twenty-five cents a week, the credit union can make that saving eventually appreciable by establishing within that man the habit of saving periodically. Credit union shares have a par value of $5 and are payable in cash, or 25 cents a week. If a man wants to save $1 a week, he can take four shares; for $2, eight shares, etc. The credit union of the plant has its office next to the paymaster's window. It is arranged to suit the time and convenience of the person going to save. It is not only gaged to his savings capacity, but it operates entirely for the convenience of the saver.

In order to have as many of the employees of the plant interested as possible, the credit union of a particular plant is organized accordingly. The board of directors, for example, chosen by and from the group who are to be served, are not only directors but salesmen. It is part of the job of the director from the shipping room, for example, to see that the employees in the shipping room come into the credit; it is part of the job of the director from the office to see that all employees in the office come in, and so on.

The value of the credit union is to get the employees to save something and gradually bring them up to where they are saving up to their full capacity to save. The next feature of the credit union is the use of the money. The credit union loans to its members the money it has accumulated. Here it is of great value to the person without security who would not be able to go to a bank and get credit at bank rates. In this way it is a valuable agency against usury. The worker who is in acute need of credit and has no place to go is at the mercy of the money lender who invariably charges an exorbi-

[8] Roy F. Bergengren, Credit Unions—Their Operation and Value. American Management Association Annual Convention, New York, March, 1926.

tant rate of interest. A licensed money lender can charge 36% on $300. In some states he can charge as much as 42%. Under a credit union the worker cooperates with his other fellow employees in the industrial unit and creates credit resources for himself, so that in time of need he can secure a loan at approximately bank rates of interest.

The question is sometimes asked, "can credit unions do business safely?" A credit union is under the direct supervision of the state department of banking of the state in which it is located. Twenty-four states have authorized their organization by law and in all of these states the credit unions are under direct state supervision. The New York City Hall has a credit union of eighty-seven hundred members employed by the city, doing a business of over a million and a half annually. In ten years, the total losses to the credit union amounted to $40.

The expense of maintaining a credit union is comparatively small. The credit union of Bird and Son, Inc., with a membership of approximately 900 has a clerical expense estimated at about $1,800 a year, borne by the company. Their credit union which has been in existence for over ten years has done a business of three-quarters of a million dollars and has fully demonstrated its usefulness.

Mutual Benefit Associations.—Mutual benefit associations, a popular form of employee association, serve to relieve financial distress incident to illness. Ordinarily membership is voluntary. The usual plan is that each member pays a small sum of money (perhaps ten or twenty-five cents according to the amount decided upon) into the treasury weekly. In return for this payment the association agrees to pay a stipulated amount per week to any member who is absent from work on account of illness or accident and a specified amount to the members of the family of an employee who dies while in the service of the company.

Some concerns supplement the contributions of the employees, others pay any incidental overhead expense and give the necessary publicity. Some concerns have deductions for dues made through the payroll, other concerns do not believe in payroll deductions. Most concerns agree, however, on one vital point, and that is that the management of the association should be left solely in the hands of the employees themselves. Choosing the directors from among them-

selves has many advantages. The members feel free to talk with directors whom they feel are one of themselves; in turn, the directors can talk to the members in their own language. If a member does not pay his dues or asks for benefits he is not deserving of, the employee director can talk to him in a manner that the employer could not use without incurring resentment. Another decided advantage is the training and development of those employees who take an active part in the management of the association. The company stands in the position of advisor to the employee directors, making them feel that it is always ready and willing to give advice and whatever assistance is necessary, but that in so far as interference in the management of the association is concerned, its policy is "Hands Off." The employees invariably appreciate this attitude of helpfulness without interference.

Group Insurance.—Group insurance [9] is a means of affording life insurance protection to all the workers in a given industrial plant at wholesale rates. A single blanket policy is issued to the employer. Each employee, covered by the insurance, receives a certificate as evidence of his protection under the group policy. The certificate gives the name of the beneficiary whom the employee has chosen. No physical examination is required, the only stipulation being that the employee shall be actively at work on the day the insurance goes into effect. There is no age limit; everyone from the office boy to the oldest employee can have protection.

Some definite arrangement must be made as to the amount for which each employee is to be insured. There are three usual plans of coverage known as (1) flat amount, (2) salary, and (3) length of service schedules. Sometimes a combination of these is in force. In the case of the flat coverage, each employee is insured for a fixed amount, regardless of salary or length of service. Under the salary schedule, each employee is insured for an amount based on his annual salary up to a maximum of $5,000. Under the length of service schedule, the employee is insured for a stated amount, which may be automatically increased for each year or period of years that he remains with the company. This last schedule gives the management a means of rewarding employees for length of service and tends to maintain the stability of the working force.

[9] Information and data regarding group insurance was supplied by Henry Bruere, vice-president of the Metropolitan Life Insurance Company.

As employees have a greater tendency to leave during the early months of their employment, it is usual to require an employee to remain with the company a specified length of time (usually three to six months) before he may enjoy the benefits of group insurance.

When an employee leaves the service of a concern which carries group insurance, his insurance is automatically cancelled. A provision, however, is included in the group policy that an insured employee upon leaving, may convert his insurance into one of the ordinary forms without physical examination. Application for such conversion, however, must be made within a stated time after the expiration of his group certificate and premium must be paid upon the policy selected.

In case of permanent disability of the insured employee before reaching the age of 60, the policy guarantees to pay the face value in monthly cash instalments.

Group insurance is the cheapest available insurance, as the insurance company is able to sell protection under the group plan at about 60% of the cost of the same policies purchased for each employee individually. It may be stated with approximate accuracy that group life insurance for the average industry will cost about one dollar a month for each thousand dollars insurance. For each group it is necessary to calculate the exact cost according to the individual ages of those insured.

In some instances the employer pays the entire premium, in other cases the premium is paid jointly by the employer and the workers, in which instance at least 75% of the eligible employees must, under the insurance laws, agree to contribute.

Advantages of Group Insurance.—The advantages of group insurance may be summed up briefly as:

1. It fosters goodwill and mutual confidence between employer and employee. It reaches the employee through what is closest to him, his love for his family. He feels the company that is looking after the interests of his family is the right sort of company to work for. This tends to stabilize the working force.

2. It gives protection to employees who could not obtain protection otherwise, due to their inability to pass the physical examination required.

3. It gives protection to those who could not afford to pay premiums required for such protection.

4. Nursing care is frequently given by the insurance company under the group plan. A trained nurse upon request from the employer or employee goes to the employee's home, cooperates with the attending physician, renders the necessary bedside care while present, and trains the members of the household in the proper method of caring for the patient between visits. Such nursing care and training is much needed and appreciated by the average employee and his family. The employee recovers more readily, comes back to work sooner, and both mentally and physically is in better condition to do his share of production.

Pension Plans.—While the pension plan is the oldest form of reward for continuous service, employers contemplating a new pension plan should study future costs carefully. As the years go on, costs rise considerably under a pension plan. If reserves have not been built up for that purpose or annuities been purchased from an insurance company, even prosperous concerns cannot help but feel the burden, and for many concerns a formal pension plan of any proportions is out of the question.

No solution of the problem of caring for workers incapacitated by age can be given. The three following methods are given as suggestions of things that might be done:

1. Before the employee reaches the age where usefulness in his present job is past, give him training in another job. A study of the various jobs in an industrial plant will reveal a surprising number that can be filled by men well past their prime. When such a job is open, instead of hiring a new man, transfer an old employee who is getting near the point where he is no longer able to hold successfully his old job. The average workman who has been with a company for a long term of years is very reluctant to leave the shop and be separated from his old associates. The shop has become a part of his very life.

The writer has in mind an old machinist who was given a liberal pension and retired as a fitting reward for forty years of faithful service. The men in the shop gave the old man a dinner and presented him with a gold watch appropriately inscribed. That was the proudest day of the old man's life. He fairly glowed in happi-

ness over the fine treatment given him by his company, and as he termed it, the "boys" in the shop. A week passed and John began to be a familiar figure around the gate when the closing whistle blew. Another week and he was there in the morning when the men came to work. Old habits are strong, he sorely missed the plant and his old associates. At last he could stand it no longer, and he came back with tears in his eyes and begged to be taken back. He was willing to give up the pension which had spelled ease and a comfortable old age to him so short a time before. He said he would do anything just to be back with the boys. After a frank talk with him, the superintendent gave him a job in the toolroom where his skill as a machinist could be used to advantage and where he would not have to exert strength or keep up with production. He was paid less than on his old job, but even at that he wanted to give up the pension that had been awarded him. Finally a compromise was made and he agreed to take half the pension to "help out" with his lowered wages. As he rather pathetically put it in his joy in getting a job, "You can give me that pension you were giving me before, when I get too old to work. I have lots of work left in me yet," and he squared his shoulders and went whistling to his new job.

2. A solution that is sometimes suggested is to develop a side line involving light work or to set up a salvage department. If such a thing can be done on a self-sustaining basis, it greatly relieves the problem, as the worker still retains his independence. In addition, the morale of the working force is strengthened. The employees know that loyalty is appreciated and rewarded, and that employees are considered as a part of the organization, and not as if they were a machine to be cast aside when it is no longer useful.

3. Another method is to build up a trust fund, the employer and employees both contributing, the fund to be used as pensions for employees after they have reached a stated age and have been with the company a specified length of time. Under such a plan the worker is preparing at least in part for his old age, and the pension is no longer looked upon as a dole.

Profit-Sharing.—The practice of profit-sharing in industry appears to be growing, even in the face of many confident beginnings and disillusioned endings. Perhaps many of the failures have been due to a misunderstanding of what properly constitutes profit-shar-

ing. Only too often at the end of a prosperous year in a spirit of philanthropy the board of directors of a company agrees upon sharing the profits with the employees. Such action is in reality more in the nature of a gift, which pleases the worker, but at the same time raises his hopes for more. If at the end of the next year, the worker does not receive as large a sum or larger, he is very likely to feel that he has a grievance against the company; he feels he was led to expect something he did not receive. In fact, he feels the company owes it to him.

The basis of all true profit-sharing plans is an agreement whereby the employees receive, at stated intervals, in addition to their wages, a certain predetermined share in the profits of the company. Profit-sharing tends toward a unity of interest on the part of the management and the participants. As such it has its value. The main weakness lies in the fact that profit-sharing does not take into consideration individual effort. The conscientious worker who puts forth every effort shares in the same proportion with the idler. Where individual efforts cannot be measured, as in the case with many salaried positions, a profit-sharing plan carefully worked out to meet conditions under which the plant operates could probably be used to advantage. For the employee whose individual contribution can be measured, a bonus in direct relation to his individual achievement is to be preferred.

The average worker prefers immediate reward, a bonus in his weekly pay envelope. A share in the profits once a year is too remote and too uncertain. For a few weeks or a month following distribution of profits he is very likely to put forth every effort, but as time goes by, the share in the profits seems very far off. The reward the worker wants is the one that comes immediately and that he can calculate himself and depend upon. For a discussion of wages and incentives see Chapter XXX.

Employee Representation.—By employee representation as here used is not meant participation in the active management by employees sitting in on the board of directors, but rather an agreement between employer and employees whereby representatives of both meet at stated intervals for the purpose of discussing matters which directly affect the workers. The representatives of the employer are chosen from among those comprising the active management of the

company, while the workers elect their representatives from among themselves. In this way, complaints and grievances are amicably settled and a common understanding reached between employer and employees.

Cooperation brings results. The representatives of the employees and of the management, meeting together and discussing matters of common interest, develop confidence in each other. The employees present their problems, knowing the management is honest and sincere in its endeavor to do justice by the working force and in turn management has a means of presenting its problems. While the average workman is not trained for solving the bigger problems of management, he is interested in company policies and problems in regard to wages, working conditions, health, safety, hours of work, education, various employee activities, etc. It may even be desirable to discuss subjects which do not intimately concern the worker, so that he may appreciate the breadth and variety of management problems and the reasons back of company policies. If properly done no harm could result, and there are possibilities of real good. All workers are vitally interested in the question of wages. Is the employee's share in the revenue of the company correct? The average workman reading in the newspaper that his company has reserves of two million dollars thinks of that money as lying idle in the bank waiting to be distributed among a few stockholders. He does not realize that the reserves may be built up to take care of bond issues. He thinks that higher wages should be paid, that the workers should receive part of that money, in fact that it belongs to them and is being held out on them.

Such questions and the resultant wrong ideas acquired on the part of the workers could be eliminated to a great extent by having the figures on the balance sheet explained to the representatives of the employees in simple language that could be readily understood by one with little experience in financial matters. Similarly, the average employee knows little of the subject of overhead. It is a revelation to him to know to what extent extravagance on his part in the matter of grease, oil, small tools, waste in material, etc., adds to costs and decreases the amount of money available for wages. Ignorance of true conditions is the cause for many complaints and suspicions directed against management. If employee representation, through bringing about a closer contact between employees and management,

can substitute knowledge for ignorance, the source of a large percentage of the troubles in industry will be done away with.

Before deciding to introduce a plan of employee representation into a plant, the management should ask itself several questions:

1. *Why does it want employee representation?* Is it just because the John Doe Company has it? Because Smith Company or Brown Company has employee representation is not a legitimate reason why Jones Company should have it. If Jones Company is not sincere in saying they want their employees to have a voice in matters directly concerning them, then why have it?

2. *What object has the company in mind?* If all you intend to do is to conciliate labor by a pretense of giving them a voice in the management, do not expect success. You will reap as you sow. If the workers feel that they are asked to give advice with the intention of ignoring the advice after it is given, they will very naturally resent it. If the intention is to have employee representation merely as a sop to labor, you might better let well enough alone. The workers are not stupid. They readily see through any such intentions.

3. *How far is the company willing to have the plan go?* Do you only want it because you see labor troubles ahead and want to ward them off? Do you intend to let the plan gradually drop out when everything becomes peaceful again? The successful employee representation plan is the one established from a long-range viewpoint. This must not be construed to mean that a plan for employee representation should not be inaugurated when labor troubles are brewing or when there is a strike on hand. It means that a plan, no matter when put into operation, should be put in with the thought of having it permanent, of working for good, healthy labor relations, and not merely as an expedient to bridge a trying time.

Is employee representation to stop at dealing with complaints and grievances? If so, that fact should be stated from the very outset. Prompt and amicable settlement of grievances contributes more to plant morale than any other single factor and should at all times be one of the chief reasons back of any employee representation plan, but employee representation can be made to go farther than the handling of complaints and grievances. It can be made a constructive force in waste reduction, accident prevention, the fostering of employee activities and in many other ways.

4. *What are the relations between management and employees at*

the present time? Do the employees trust the management? The average worker looks for good wages, security in his job, working conditions conducive to his health and well-being, a good boss to work under and reasonable opportunity for advancement. This may sound a lot, but after all it is only fair and just treatment and what the worker should reasonably expect. If there is such a foundation, a plan of employee representation will undoubtedly succeed to the mutual advantage of employer and employees. Where there is no such foundation, it might be better to begin to build it up before inaugurating the plan. If representation is substituted for a needed and deserved increase in wages, the effort and time expended are wasted. The worker is interested primarily in his pay envelope. It contains the wherewithal for life for him and his family. He naturally expects it to be as good as economic conditions and his own individual effort permit.

Similarly with working conditions. Of what good is representation if the workplace is a poorly lighted, dingy shop which takes from a man all sense of well-being? Better to clean up that shop, to have it properly lighted and heated. Likewise with the question of the boss. If the boss is a surly fellow, one who plays favorites, or one whose word cannot be depended upon, the question of replacing him with a man who is capable and unbiased comes home closer to the worker than does the question of whether employees are represented or not. It is better to put "the house in order" and to lay a good foundation before any attempt is made to build upon it. If not, either complaints and grievances will pour in in such volume that they cannot receive prompt and adequate attention, or the workers will mistrust the intentions of the management or feel "what's the use."

Mechanism of Employee Representation.—Employee representation is not any one set plan. It is simply a method, the details of which differ widely in different plants so as to meet local conditions. In most instances, best results are obtained by having employees and management work out the plan jointly, for in that way both groups have a personal interest. It is this personal interest, this spirit of working toward a common goal that is the real test of any employee representation plan. The most perfect plan as far as mechanism is concerned will fail if the proper spirit back of the plan

is lacking. Similarly, a plan not so well-developed may be a splendid success if the right spirit is present.

In practice there are two main classes of employee representation plans:

1. Those with advisory powers only.
2. Those which provide for arbitration as a final resort when differences cannot be settled otherwise. This provision, however, rarely has to be exercised. In one company, handling under an employee representation plan nearly a thousand cases, only in one instance was it necessary to arbitrate.

Industrial Democracy Type.—All plans of employee representation are based upon one of two general types—the federal or government type sometimes called the industrial democracy type, and the works council or joint committee type. The federal or government type as the name indicates follows government procedure. The house of representatives is composed of elected representatives of employees. The senate is composed of foremen and minor executives and the cabinet is made up of higher executives. The president of the company may be numbered among the latter. Under the federal type a bill is prepared in the house, and after passing is sent to the senate. If it passes the senate it goes to the cabinet for approval before becoming effective. In case of veto, provision is made for reconsideration and amendment. While the federal type has ardent supporters, it is generally conceded to be rather cumbersome.

Works Council Type.—The works council or joint committee type is a simpler and more flexible type which is rapidly growing in favor. Usually the works council is organized along departmental lines. The workers of a given department elect their representatives for their department committee; the management likewise selects representatives for that committee. The representatives of the management and of the workers meet together and deal with matters concerning that department. Workers in a department frequently have problems peculiar to that department. Under the joint committee type, the very great majority of problems are settled in the department committee without affecting in any way the other committees. If they cannot come to a decision, the matter is usually referred to a general

committee, and if necessary to some designated higher executive, or in an extreme case to an arbitration board. The latter, however, is very rarely needed.

Many variations of the above types are found. The American Multigraph Company,[10] for example, favors the federal type but does

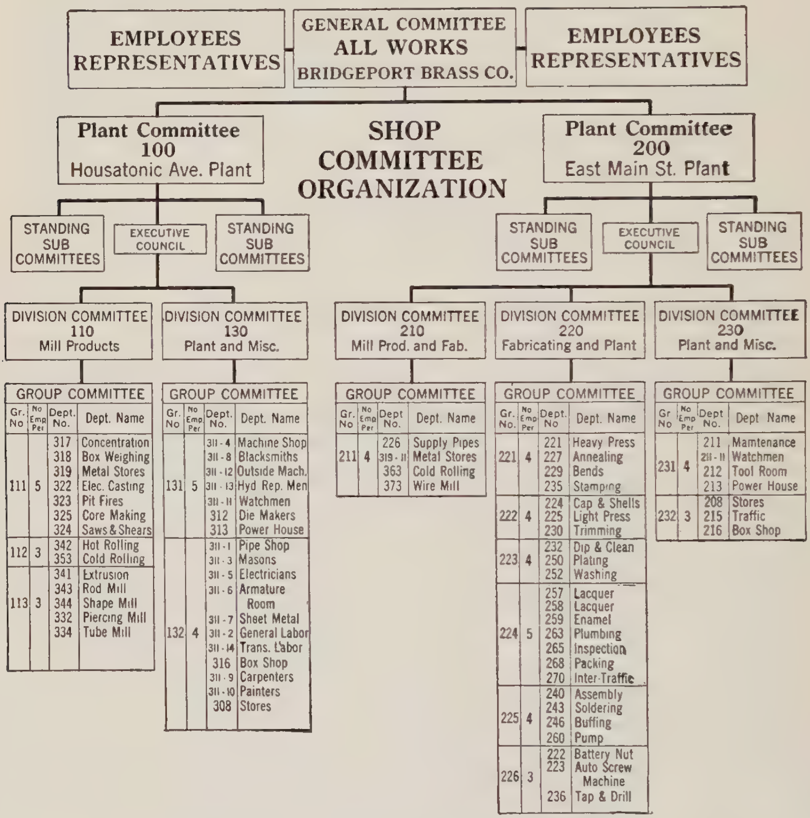


Figure 64. Shop Committee Organization

not have a senate. The house or congress is composed of twenty-four members elected at large and in addition representatives elected departmentally. Action of congress goes direct to the cabinet for approval, veto or amendment. The latter is composed of senior

[10] Adapted from a paper read by T. H. White, manager of industrial relations, The American Multigraph Company, at a conference of the American Management Association held at Chicago, November, 1926.

executives appointed by the company president. In order that foremen and minor executives should not be deprived of all participation, permission is given them to serve in congress, providing, of course, that they are regularly nominated and elected by general vote of the employees.

The type of employee representation selected or any variations made is unimportant, provided the plan selected fits the particular circumstances. The following suggestions were given by F. M. Dee, Jr., of the Business Research Corporation.[11]

Principles of Representation Plan.—

There are certain guiding principles which might well be followed in the preparation of any representation plan. 1. The object of the plan should be clearly defined so that there is no doubt as to its intent and purposes. 2. The organization of agencies for carrying out the principles set forth should be stated in no uncertain terms; language should be used that is easily understood by the least educated employee. 3. The duties and powers of these agencies for representation should be consistent with the purposes of the plan. 4. The method of procedure agreed upon should be such as to provide the most effective contact between management and employees. 5. The provisions for amendment should be ample and permit such changes as are proved necessary by experience.

Within the plan itself there are certain matters which are of particular interest to employees and seem worthy of incorporation: that (a) employees be permitted to present for impartial consideration and prompt action all matters which affect them as employees; (b) adequate representation be provided so that all employees may have their grievances, problems or difficulties properly submitted for consideration to those who can adjust them; (c) the secret ballot be used in the election of employee representatives; (d) representatives be guaranteed freedom from interference on the part of supervisors, where such representatives are working in good faith in the interests of their constituents; and (e) the plan provides that no employee shall suffer discrimination on account of race, sex, political or religious affiliations.

[11] F. M. Dee, Jr., Various Types of Employee Representation Plans Designed to Fit Local Conditions. Presented at the Conference at Chicago of the American Management Association, November 18, 1926.

CHAPTER XXI

POWER AND MAINTENANCE DIVISION

Power—Its Importance in Industry.—Before discussing the scope of the power and maintenance division and the duties assigned to that division, it is well to know something of just what is included in industry under the term power, and the problems involved in supplying power. For those concerns in which production depends in a large measure upon a constant and regular supply of power, the power available or the fuel needed to generate that power and the dependability of the source of supply may be the deciding factors in the location of the plant (Chapter VIII). A shut-down due to failure of power is a serious condition. In many plants production practically ceases with the failure of power. Machines are idle, promised deliveries cannot be made, losses due to unearned burden pile up, direct labor costs continue in those concerns where day rate is guaranteed and where no such guarantee is given the company likewise suffers, as the workers, being deprived of their opportunity for earning, are dissatisfied and are very likely to blame the management rightly or wrongly, as the case may be. In some instances spoilage results due to interruption of the production process. In all cases, production schedules are deranged and operations interfered with, with the resultant losses which quickly run up to a sizable sum. Concerns buying power frequently have a clause in their contract with the central power company whereby, when power fails, the central power company pays to the consumer a specified sum for each specified unit of time which elapses before power is resumed. In some instances the power company is allowed a short period of grace, the length of such period being set forth definitely in the contract. In the matter of power, dependability of source of power is the prime requisite; economy, while important, is secondary in this instance.

Determining Power Needs.—The average person considers power needs as being restricted to the power needed to operate the

various production centers, particularly heavy duty machinery. True, the greater part of industrial power is consumed by the production centers, but provision must also be made for other needs, each of which may be comparatively small, but the total of which is considerable. Reference is made here to power needs for heating and ventilating, lighting, and operation of ovens and furnaces and various types of auxiliary equipment (portable electric drills, pneumatic hammers, blower systems, elevators, cranes, etc.).

Buy or Generate Power.—The question of whether to purchase power from a central station or to generate power is for the individual company to decide. For the small plant, ordinarily it would be simpler and less expensive to purchase power. The efficient generation and transmission of power involve technical problems with which the average factory manager is not fully familiar. Unless the system for the generation and transmission of power is laid out by a competent engineer trained along those lines, many avoidable losses in generation and transmission are bound to creep in, and what is of far greater importance, production is very likely to be interrupted and hampered. A plant consuming considerable power and desiring to operate a power plant of its own can well afford to employ a competent consulting power engineer. The fee of the consultant would be far more than offset by the advantages to be gained from his services. Due to his knowledge of power plant requirements and his experiences in handling similar problems for other concerns, the consulting engineer can design a power plant for the most economic production and distribution of power for the concern in question.

In operating a power plant, lowest costs are obtained when the power plant is designed to operate the equipment at full capacity, and all production centers are running at 100% production. Such conditions, however, are very rare in practice. Consumption of power fluctuates from time to time. If the business is a seasonal one, fluctuations are marked between seasons. Similarly, there are daily fluctuations. Early morning, when the day's work is starting up, usually shows a maximum demand for power; later in the day the demand falls off. Other smaller fluctuations occur from time to time during the day as, for example, when machines are started up and stopped. All such fluctuations must be considered in planning to meet power requirements. Different companies meet their power

requirements in different ways. Some purchase all power from a central station; others maintain a complete power plant equipped to care for maximum power needs. Some concerns take a middle course. They either generate their normal needs and arrange with a central station to care for peak loads, or purchase their normal needs and generate sufficient additional power to care for peak loads. Having an arrangement to purchase at least some of the power required is a wise precaution against power failure due to accident in the company's power plant.

Factors Favoring Company Power Unit.—Under certain circumstances, a company profits from maintaining its own power plant. The following are among the factors favoring the company power unit:

1. *Unusually low price of fuel.* The central station in figuring the cost of power to the consumer must add to its cost of production charges for distribution and incidental expenses (poles, wires, meters, accounting, etc.). When the price of fuel is low, these charges considerably increase the purchase price of power, and may make it high compared with the cost of company generated power, even though actual production costs may be decidedly lower due to the superior efficiency of the central station. Conversely, when fuel costs are high the distribution and incidental expenses are relatively small, and are more than offset by the more efficient means and methods of the central station.

2. *A great deal of waste from the manufacturing process which may be used as fuel.* This serves to dispose of what otherwise might be a troublesome problem, and at the same time lowers the cost of generating power, as at least part of the fuel used costs little more than handling charges, a small item if the proper mechanical handling equipment is used.

3. *A manufacturing process which requires large quantities of steam.* With a power plant, steam for process work and for plant heating can be produced largely as a by-product, for steam, after furnishing power to produce electrical energy, still contains about 90% of its original heat.

4. *Likelihood of interrupted service if power is bought from a nearby central station.* With our present modern central stations, however, this factor is largely eliminated.

Factors Against Company Power Unit.—Weighed against the factors favoring the company power unit are:

1. The cost of the power unit.

(a) Value of the space used. Could it be used more profitably and is it urgently needed for some other purpose?

(b) Cost of equipment (boilers, engines or turbines, generators, switchboards, condensers, coal and ash handling machinery, etc.). The argument is sometimes given that much of this equipment must be used anyhow in generating steam for heat. Generating power requires high pressure. If steam is generated for heat alone, low pressure boilers and apparatus are all that are required. Boilers and auxiliary apparatus must be especially designed and constructed to withstand high pressure and are correspondingly greater in cost.

(c) Is it wise to tie up capital in a power plant? Would this capital return higher rate on investment if used in production work?

(d) Interest on power station buildings, depreciation, maintenance, repairs, taxes and insurance.

2. Cost of fuel and water required.

3. Cost of labor and supervision in the power plant.

4. Cost of handling of fuel and ashes and their disposal.

5. Where the load factor is low, the cost to a company producing its own power will be considerably higher per unit of power than if it had a high load factor. The load factor of a given plant is found by dividing the average power load by the maximum power load. If the plant requires at its peak load 1,000 kilowatts and the average requirements during the day are 500 kilowatts, the load factor is ½. A company generating its own power must have equipment in this case to provide 1,000 kilowatts, even though it needs but half that amount the greater part of the time. The central station charges more per unit of power when the load factor is low, but not as great an increase as the additional cost per unit of power would be in the company power plant when the load factor is low, over when it is high.

Each manufacturing concern has a power problem peculiar to itself which can only be solved after a complete survey of conditions, weighing the advantages and disadvantages of buying power and of making it in its own plant.

Survey of Power Conditions

Types of Drive.—Electric transmission is used to convey power to the various machines and workplaces where it is utilized by electric motors. There are three types of drive: (1) single motor drive; (2) group drive; (3) individual or unit drive.

1. Single Motor Drive.—With the single motor drive, one motor large enough to drive all the machines in the shop is used. The motor is belted to a line shaft which, in turn, drives a series of short jack shafts and machine countershafts. While the single motor drive is low in first cost, it is not flexible, its friction load is high, and it is not as efficient as the group drive or unit drive. In practice, the single motor drive is not commonly used.

2. Group Drive.—With the group drive, one motor is used to drive a related group of machines. To operate group drive efficiently, the group drive should be located compactly and should consist of such machines as would require to be driven at similar speeds and with little variation of load. This is the type of drive most generally used, as its advantages for the average case far exceed the disadvantages in comparison with both single motor drives and unit drives.

3. Unit Drive.—In individual or unit drive, as the name indicates, each machine has an individual motor. Unit drive is employed for some of the large heavy duty machines, especially those which are not in constant use, also for portable machines and portable electric appliances of various kinds. In the average shop both unit drive and group drive are found, each type being used where it is of best advantage.

In a comparison of all three types of drive the following conditions are found:

(a) *Initial Cost.* The initial cost is lower with group drive than in those cases where each machine has its own motor, although higher than the single motor drive.

(b) *Motor Capacity.* The motor for a group can be operated more nearly at its maximum load most of the time than can a number of small motors, as the group motor is usually of smaller capacity than the combined power needs of each machine in the group. With unit drive, each motor must be of capacity to take care of maximum

demands of the machine it drives. With the group drive, only the average load with a fair margin of safety need be provided for, as it would be a rare instance in which all the machines in the group would demand maximum power at the same time. Each machine in the group operates only a portion of the time, the remainder of the time is taken up with putting material into the machine and taking it out. This advantage of the group drive is even more pronounced in the single motor drive. Generally speaking, power fluctuations vary in inverse proportion to the number of machines driven by a motor. When only one or two machines are operated by a motor, a shutdown of a machine or the throwing on of power makes a radical difference in power requirements. As the number of machines driven by the motor increases, the effect of such occurrences on the part of an individual machine affects the work of the motor less in proportion.

Group drive permits of using a few efficient, slow-speed, large motors, in place of a greater number of smaller high-speed motors with less efficiency.

(c) *Friction Losses.* Losses due to friction are greatest in the single motor drive, less in the group drive, and least in the unit drive.

(d) *In Case of Breakdown.* With single motor drive, in case of accident to the motor or main shaft all machines in the entire shop requiring power are shut down until repairs can be made. Under group drive, with the failure of a motor the only machines affected are those in the group driven by that particular motor. Under unit drive the breakdown of a motor affects the operation of one machine only.

(e) *Flexibility of Speeds.* With the single motor drive all machines in the shop, regardless of the type of machine or character of the work, must be driven at one of but a few speeds, depending upon the ratio of the pulleys used. With group drive, machines requiring to be driven at a similar speed can be grouped together. With unit drive, each machine can be driven at the speed best suited for that machine, the speed control being very flexible when individual motors are used.

(f) *Arrangement of Machines in the Shop.* Good plant layout can rarely be attained when the single motor type of drive is used. The position of the shaft determines to a considerable extent the location of the machines. In addition, the shafting and the unusual

amount of belting required prevent, or at least seriously interfere with, the use of cranes and other overhead equipment, and add materially to the lighting problem, the belts cutting off much of the light. Arrangement is more flexible under group drive, and most flexible under unit drive. With the latter, a machine can be placed wherever it fits in best with the plan of layout; changes of position and additions can be made readily without interfering with the operation of other machines; overhead space is clear, permitting the use of any overhead equipment necessary; and the lighting problem is greatly simplified.

(g) *Maintenance.* Aligning and lubricating of shafting, repairing and caring for belts, add materially to the maintenance cost under the single motor drive. This disadvantage is present in a lesser degree in group drive.

Reducing the Cost of Generating Power.—There is no good reason why there should not be continuity of service and economy of production and utilization of power, light and heat, if all influencing factors are given due consideration. A thorough discussion of power plant operation is without the scope of this text, interesting though the subject may be. The subject of cost reduction in power generation and utilization is broad; the opportunities are many and varied. The following are given as suggestions of some of the things that may be done:

1. Location of the power house. Two main factors enter into the location of the engine room or power house, namely: (a) Provision for economical delivery and handling of fuel; (b) The distance from the power house to the operating centers to be served should be short. Unless the distance over which electric current, steam or compressed air is transmitted is short, wastes and costs increase.

2. Design of power plant, its layout and equipment, should conform to the dictates of best engineering practice. If after the power plant is put into operation it is found that it is not designed for economical operation, it is usually too late to make changes, as alterations would be too costly. The best engineering advice at the very beginning is cheapest in the long run.

3. Cost of power plant should be kept as low as adequate service and economical operation will permit. The most expensive equipment is not always the best for the purpose. Simple, inexpensive

equipment, if it is reliable and will meet the needs, is all that is required. An elaborate, expensive power plant may make a beautiful picture, but it also means a big overhead, one which may keep the operation of the power house on the red side of the ledger.

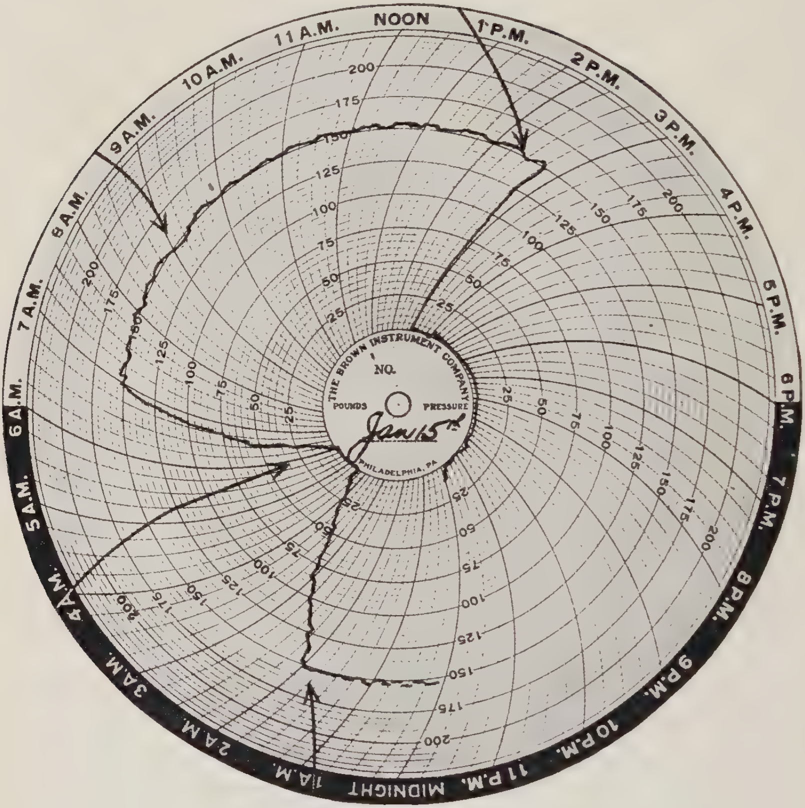
4. It should be known how many kilowatt hours, how many pounds of steam, how many gallons of hot water are required under various operating conditions. Meters should be installed to measure accurately how many of each are consumed. In this way, wastes are made apparent so they can be corrected. When power costs are high, it is frequently found that many wastes laid to the boiler room should be charged, not to the generation of power, but to the wasteful way in which it is transmitted and utilized.

5. Coal should be purchased only under standard specifications which specify B.T.U.[1] content and the penalty to be imposed for a lower B.T.U. content, also for ash and moisture in excess of a specified amount. Each plant should determine the type of fuel best adapted for its purpose and should then continue to use that particular type of fuel. B.T.U. content varies considerably between different grades of coal. Excess moisture lowers fuel value not only because water will give no heat, but also because it takes heat to evaporate the water, whereas the heat so consumed should be utilized in the making of steam. A high ash content means not only lower fuel value due to the fact that ash itself has no fuel value, but in addition, it increases the amount of dust in the flues, forms clinkers in the boiler which shut off the necessary air, and in other ways adds to the labor and cost of operation.

6. In order to judge accurately the efficiency of the boiler room, suitable measuring devices should be used. Pipes leak, pumps quit, equipment fails, men grow careless in every plant at some time or other, with the result that pressure and temperature drop off. Recorders show "when" and "how much." It is then up to the management to find out "why," for in the correct conduct of every industrial process into which pressure or temperature enters, there is a right pressure or temperature (or both) which must be maintained at a certain point or within a certain range or varied in a certain sequence for definite periods of time. When this is not done, wastes accumulate and costs rise. Charts from recording instruments are a valuable

[1] British thermal unit (B.T.U.) is that quantity of heat which is required to raise the temperature of 1 pound of pure water 1° Fahrenheit at or near 39° Fahrenheit.

aid to the management in control and cost reduction. They show management conditions as they are, they serve as a check on men and equipment and guide the men in their work, and they point out to management conditions which require attention. For example, in



(Courtesy of Brown Instrument Co., Philadelphia)

Figure 65. Recording Pressure Gage Chart

Figure 65, note that at 2 A. M. the pressure dropped off, probably the fireman fell asleep. He is running up costs, as it takes more fuel or power to bring up the pressure once it has lagged, than it does to keep it uniform. At 6 A. M., he started things up again and pressure began to pick up. From 6 A. M. until 2:45 P. M., pressure was retained at 150 pounds, then something happened and pressure dropped.

For every fuel and boiler installation, there is a definite percentage of CO_2 which will assure the best combustion efficiency. Less than the proper per cent of CO_2 means loss of efficiency, because of an excess of air being supplied. This excess air absorbs heat in being raised from room temperature to stack temperature.

It is possible to control the air supply very closely by means of the damper, the thickness of the fire and the pressure under the fire in the case of forced draft. The CO_2 meter is the only means of accurately determining the degree of efficiency of fuel combustion.

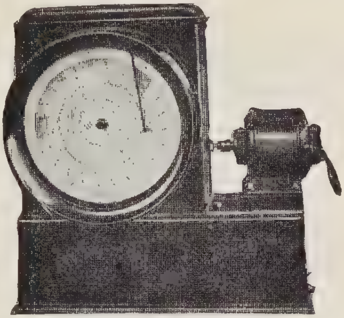


Figure 66. CO_2 Meter [2]

Flue gas and boiler last pass temperatures are easily measured with pyrometers or electrical thermometers.

The principal heat loss in any boiler is usually caused by flue gases from which the heat has not been absorbed and has been estimated to range from 12% to 40%.

A gradual increasing flue gas temperature indicates accumulation of scale inside of boiler tubes, soot, or slag on the outside of tubes. A rapid increase in temperature indicates excess air, broken baffles which allow hot gases to take a short path to the stack, and holes developing in fire bed.

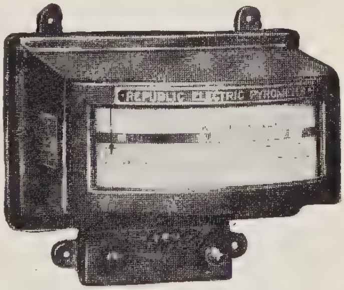


Figure 67. Pyrometer [2]

The importance of flue gas temperature is shown by the fact that a reduction of 25 degrees in stack temperature means, under usual conditions, a fuel saving of over 1%.

A check on the amount of feed water consumed by boilers is important, especially where the water supply is purchased. Its greatest value, however, lies in showing the losses from blow downs, leaks, and pop valves. This amount can be determined by the feed water meter and the total of the readings from the steam flow meters. The difference should check reasonably constant, around 2% or 3%. If there is a larger discrepancy between these two readings, it is an indication that a large waste is taking place due to the heating of wasted feed water.

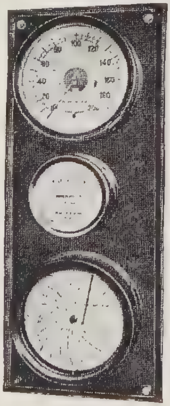


Figure 68 [2]
Water Meter

[2] Cuts and descriptive matter courtesy of Republic Flow Meters Company, Chicago, Ill.

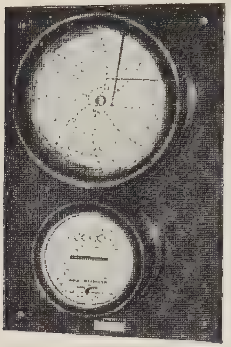


Figure 69. Distribution Meter [3]

Generally speaking, every six pounds of steam wasted equals one pound of coal wasted, in addition to the cost of water, labor, general supplies and equipment. By saving steam, all of these items are saved. Obviously, it pays to know where every pound of steam goes and how economically it is used.

Flow meters installed on departmental steam lines furnish records which are invaluable in studying steam distribution. Operations in one department can be compared with simultaneous operations in another, and in this manner the economical boiler load can be scheduled. Controversies which arise between department foremen as to their steam requirements will be quickly settled. In short, the chart record produces a picture of plant operation.

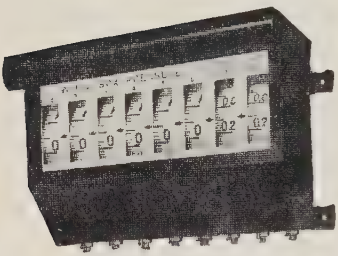


Figure 70. Draft Gage [3]

The proper regulation of draft is one of the most important factors in securing combustion efficiency in the modern boiler plant. To accurately maintain the correct draft for the present load conditions, the operator must have a complete picture of draft conditions under the fire, over the fire and in the stack.

If boilers are equipped with chain grate stokers or underfeed stokers with divided wind boxes, draft reading from each compartment should be available, because it is desirable to keep the furnace pressure slightly negative and of constant value. Here knowledge of draft over the fire is of great value in connection with pressure indications for the wind box.

7. The fact is frequently overlooked that substantial reduction in costs may be brought about through paying attention to the sources of small wastes usually found in the boiler room. Each of these wastes may in itself be of little consequence, but the sum total of all of them is sometimes astonishingly large. Such conditions as leaky pipes or valves, pipes inadequately covered, soot-coated flues and boiler surfaces, boiler scale, etc., are but a few of the sources of waste which merit attention in any sincere effort to reduce costs.

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[3] Cuts and descriptive matter courtesy of Republic Flow Meters Company, Chicago, Ill.

Power and Maintenance Division

Its Scope and Function.—The average industrial concern has a considerable investment in factory buildings, productive machinery, material handling, and other equipment. This investment must be safeguarded and properly looked after, or depreciation is rapid, the value of the investment shrinks, breakdowns occur, production is interfered with, and profits are cut down. It is only common sense to prevent undue depreciation and to endeavor to secure maximum use of property and equipment. Yet the management of many industrial concerns begrudges every penny spent on plant maintenance. Maintenance is an indirect cost, a part of overhead, therefore it is kept down to the point of bare necessities. This is a short-sighted policy. Maintenance has more to do with the protection of the investment and with the efficiency of production than is generally realized. It is not advocated that any plant should go to extremes and install an elaborate system of maintenance, but it is advocated that each plant work out a practical maintenance program to fit its particular needs.

It is unfortunate that, in many plants, the control of the maintenance function is not centralized, but rather the work is "parcelled out," with a resultant lack of fixed responsibility and coordination of effort and with decreased productive efficiency on the part of the plant as a whole. In case of emergency, a number of men may be required in a hurry in a certain shop. Under centralized maintenance the head of the maintenance division would simply take sufficient of his men off the work they are doing and rush them over to the emergency job. Where maintenance work is decentralized, a lot of valuable time would be wasted, while the foreman of the shop in which the breakdown occurred enlisted one or more of his regular productive workers, or hunted up the foremen in other shops and borrowed men for the job. Similarly, the tools and other materials to work with may have to be collected from this shop and that shop and in many cases could not be located at all, and a makeshift would have to be used, or the job held up until the correct part or material could be purchased. A properly operated maintenance division is ready for such emergencies. It has the materials, repair parts and tools all readily available, and the maintenance men understand how

best to go about the work so as to get the machine or operating center ready to do productive work in the quickest possible time.

A plant can be considered as a large machine to be kept at all times in an efficient operative condition at the lowest possible cost. The power and maintenance division is responsible for the furnishing of such services as are assigned to it and for the maintenance and repair of buildings, grounds, machinery and equipment, to the end that the plant can be operated at the high point of efficiency with a minimum outlay of money.

Specific Duties of Power and Maintenance Division.—The specific duties of the power and maintenance division depend upon the policy of the company and the condition of the plant. In the average modern plant, the following duties would be included in the work of the power and maintenance division:

1. *Upkeep of buildings, grounds, and fences.* Well-kept plant and grounds prevent undue depreciation and present a neat and attractive appearance, which is an advertisement in itself and a source of pride to the workers. Painting the exterior of the plant may be quite expensive, but it is cheaper than the replacements which are bound to be needed after a few years if the surface is not protected from rust and decay. At regular intervals there should be inspection of fences, platforms, towers, roofs, etc., noting the maintenance work that is needed and where. The method of repair and the materials to be used can then be planned and a schedule of work laid out. In most plants, the work can be done by the workmen on the payroll, many of the items being done at odd times. Where maintenance is taken care of systematically, the cost of such work is reduced materially. Needs are made evident and corrected while they are small, while if neglected they would very probably result in a costly repair job or replacement.

A small roof patch may involve the expenditure of only a couple of dollars, but if the need had not been recognized and cared for, a water leak would have resulted which may have caused considerable damage. Similarly, with a small hole in the road, a saggy fence, a rusty steel sash, and so forth. The hole in the road can be filled in with little effort and expense. If it is allowed to continue and grow larger it lessens the speed at which trucks can be driven, adds to truck maintenance and breakage in handling materials on trucks from one

building to another, and eventually it may necessitate tearing out that part of the old road and putting in new. Similarly, a sagging fence may be corrected at very little expense if taken in time, but if allowed to continue to sag and get worse, it certainly cannot accomplish the purpose for which it was erected, namely, to keep out undesirables and eventually the fence may have to be replaced. The same thought holds true in numerous maintenance items. An efficient maintenance division more than pays for itself by being alert to small needs and correcting them before they grow large and involve a big outlay of money for correction or replacement.

Orderliness and cleanliness in the shop have a decided effect on the worker. They create in him pride in his work and in his shop and give him a sense of well-being. Conversely, a disorderly, dirty shop is reflected in the quality as well as in the quantity of work produced, the attitude of the worker and in the lowered morale of the entire force. The best of workers become careless in such surroundings. A dirty floor is unsanitary and encourages unsanitary practices on the part of the worker. A good example is far more effective than any amount of preaching. When the shop is kept clean and the aisles clear, the worker consciously or unconsciously follows the example by proper care of his machine and workplace. Floors should be kept clean and free from moisture. Aisles and passages should be kept free from holes, cracks and sags. A periodic inspection will note causes of failure and their prompt attention will do much to lessen the cost of upkeep. Likewise with the question of windows. Daylight factories are built at great expense, yet many are seen in which the windows are covered with dust and grime. Clean windows not only make the shop a more wholesome and cheerful place to work, but they reduce lighting bills and in that way more than pay for the cost of the cleaning. If walls and ceilings are painted a light color, they add to the attractiveness of the workshop and so foster plant morale, and at the same time increase light reflection. Painting of the interior of the shop is, therefore, not only a question of maintenance but one of lighting.

Proper maintenance for factory buildings and grounds keeps down costs of repair and replacements, lessens depreciation, encourages plant morale, and eliminates many causes of accidents. A worn or loose tread in a stairway can be readily replaced or repaired, yet if

allowed to remain in its present condition it may be the cause of a serious accident.

2. *Fire and plant protection.* Even in the case of factories under city fire protection, the employees in the maintenance division should be trained as to their respective duties in case of fire. Immediate action in the case of a fire may be the means of preventing serious damage. Plants located at a distance from a city should maintain an adequate factory fire department of their own. While the men employed in productive work may be trained in what to do in case of fire and their services may prove very valuable in such an emergency, the employees of the maintenance division are the logical ones around which to organize the company fire department. These men are familiar with the plant as a whole, and the location of the fire fighting apparatus and equipment. The knowledge of the regular production men is usually restricted to that of their own shop.

Adequate fire protection apparatus and equipment should be provided and regular inspection made of it to insure its perfect operation when wanted. The equipment may be seldom if ever needed, but it must be kept ready for instant use. It may give a feeling of security to have the proper equipment on hand, but it is a false security if the equipment is not properly maintained ready for use. Hand equipment should be so placed that there will be free access to it at all times. The operation of automatic equipment must not be interfered with. Check on both of these points is necessary. Hose may become defective even though never used, hand extinguishers require refilling as recommended by the manufacturers. Fire extinguishers are of various types, each devised to meet certain conditions. An ordinary rubbish fire may be put out by a certain type of extinguisher, an oil fire requires a different type. In order to differentiate between the various types and so be able to select instantly the proper type, each type is painted a distinctive color. Similarly, water pails are painted red and a warning posted that under no circumstances are they to be used except in case of fire. Even with such a warning it is necessary to make frequent inspection to see that the pails are in place and that those which should contain sand are properly filled. Likewise, regular inspection should be made of fire pumps, valves, fire plugs, and similar equipment. A missing valve wheel, a corroded sprinkler head, a missing wrench, a defective piece of hose, any of these relatively small items may be the cause of a severe loss in

case of a fire. It is the duty of the maintenance division to see that no such condition is allowed to exist. Certain fire protection equipment may require daily inspection, others weekly, and others at less frequent intervals.

Fire escapes should be inspected for need of painting to prevent rust, and for condition of supports and fastenings. Exit doors and doors in fire walls should be kept in good condition to safeguard the employees.

The responsibility for the effective operation of all fire protection measures is laid to the maintenance division. It is their duty to see that all combustible refuse is collected in metal containers and removed from the plant at the end of each day, or burned under the boilers; that smoking is prohibited in any place where there is any danger of fire; that inflammable liquids or materials are stored in fireproof locations; that all open fires and stacks giving off sparks are guarded by hoods or arrestors and that any other necessary fire prevention measures are devised and strictly enforced.

Under the heading of plant protection is included policing and guarding the plant. This includes providing gatemen who are expected to question all who desire to enter or leave the plant and about whom the gateman is at all in doubt. Usually employees are provided with a company identification button or badge giving their clock or payroll number and the number of the section or shop in which they work. This button they are requested to wear in plain sight at all times while on the company's premises, and are required to show it to those who have authority to ask to see it. If the gateman is at all in doubt as to the propriety of a man entering the plant, he asks to see his button and he is expected to keep him out if the man cannot produce it. He may, however, give the man an opportunity to telephone to his foreman for a pass to permit him to enter. Similarly, if an employee leaves at an unusual hour the gateman is expected to find out why and to take his number and immediately report it to the foreman or supervisor of the shop or section where the man works. This is a check on the type of worker who rings in and then likes to slip out for a while to get a bite to eat or to go to the ball game, returning in time to ring out with the other men at the closing whistle.

Company detectives also come under this heading. While many object strenuously to the very thought of detective work of any sort, there are circumstances under which it may be necessary. Policing

and guarding further include the reporting of any suspicious characters loitering around the plant and keeping track of their movements, the reporting of fire hazards and possible sources of accident, and plant safeguarding and protection in general.

3. *Supply heat, light, power, compressed air and any other service required.* The power and maintenance division is responsible for supplying heat, light, power, live steam, compressed air, water and any other service required. The consequences of failure of the supply of any of these services may reach large figures. The first consideration is their economical production. As production of such utilities involves questions of technique outside of the scope of this text, we will dismiss that side of the question with the one suggestion, namely, that a study be made and the most suitable equipment for the work be installed. The advice of a competent engineer who has studied the special conditions is essential as many factors are involved. From his experience and intelligent consideration of surrounding conditions, he can plan an installation which will operate efficiently and economically, and can make suggestions as to operating economies which could otherwise only be discovered after months of the costly trial and error method.

The second consideration and the one with which we are here most concerned is the proper maintenance of equipment. Proper maintenance and care of distribution lines and appurtenances are essential. All important equipment should be inspected periodically and a regular routine of procedure of maintenance followed. Maintenance of piping is an important item, as failure may result in a part of the plant being shut down. The highest grade of packing should be used at all joints and valves so as to insure maximum length of service. Steam pipes should be covered and the covering kept in good condition to prevent wastes due to radiation. All pipes should be painted distinctive colors or otherwise marked for identification purposes. All hydrants, spigots, flush tanks, drinking fountains, etc., should be regularly inspected to insure proper service and to prevent undue waste of water.

Motors should be frequently checked for capacity, cleaned and new brushes put in. Meters, gages and other measuring instruments should be calibrated regularly. Alignment of shafting should be checked and bearings adjusted and lubricated. Belts should be tested

for proper tension and adjusted, and the belts treated with the proper belt dressing to prevent slippage.

Where all electric wires are installed in conduits, switches are protected in safety panels and switchboards are guarded with wire netting guards, the lighting system will require comparatively little attention. Inspection at certain intervals is necessary, however, to seek out any chafing of insulation or broken conduits, to consider the advisability of changing the location of lighting units or the need for additional lights to improve the efficiency of the lighting system. The cleaning of lamps and reflectors is a small item of maintenance that is sometimes slighted with rather serious consequences to the efficiency of plant lighting.

Increased use is being made of compressed air, a valuable working tool for driving machines, hoists, tools, cleaning, and so forth. Economical production, storage and transmission of compressed air are essential, as it is a rather expensive utility and one which is unusually easy to waste. Leaks are hard to detect and yet a number of minor leaks quickly result in quite a sizable loss. Attention should be given to all air lines, valves, pipe fittings, and air tools at regular intervals to insure against leaks and to make proper repairs and replacements when they do occur. Employees should be cautioned against the unnecessary use of compressed air as such wastes put extra demand upon the air compresser and it may not be able to keep up the pressure required for driving the air-driven machines and tools.

4. *Make emergency repairs.* Emergency repairs or breakdowns should be taken care of promptly, regardless of the expense or effort involved. In order to prepare against breakdowns due to failure of a motor, it is a good idea to have on hand an extra motor of each size used in the plant, so that one can be put into service immediately in place of the one that has failed. This method is only practicable when motors have been standardized to a few sizes.

When it is a question of getting a large machine back into production, the head of the maintenance division takes a gang of men off their regular maintenance work and has them devote all of their efforts to the repair job, working in several shifts if necessary. Until the machine is repaired and in operation, expenses mount steadily. There is loss of time of the machine, loss of time of the operator, loss of production. It is the duty of the maintenance division to reduce this loss to a minimum. It is in times of emer-

gency that maintenance men prove their resourcefulness and demonstrate the value of the work of their division. In this respect a portable repair shop such as shown in Figure 71 proves invaluable. A study of repair records will show the various tools and materials required for the average emergency repair job. An electric truck suitably equipped and stocked can be kept in readiness to be run at a moment's notice to any emergency job which may come up. The effort, confusion and delay incident to deciding upon and collecting tools and materials are done away with, and the truck transports tools

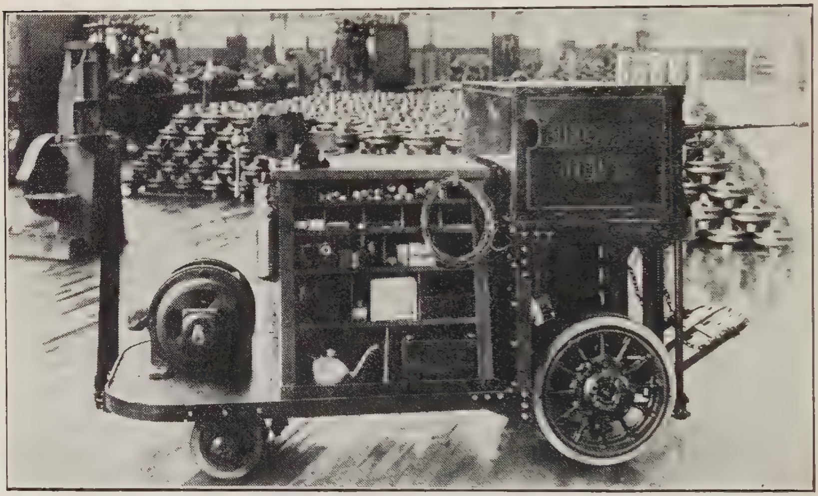


Figure 71. Portable Repair Shop

From *Management and Administration*, May, 1925, p. 483.

and materials, and a repair man or two, as the job demands, to the place of the job in but a fraction of the time it would take the men to walk there.

5. *Make systematic inspection of all machinery and equipment so as to detect anything which might cause breakdown of machinery or failure of equipment.* The interval between the periodic inspections varies with the particular machine or kind of equipment. The class and amount of work done, the extent of wear and tear caused by the particular operations performed, the construction and condition of the individual machine or piece of equipment, all are deciding factors in determining the length of time between inspections.

Each machine has certain parts more subject to wear than other parts. To these, special attention should be given and reports made of their condition. Grinding machines kept on precision work must have the bearings examined frequently, as they must be kept in very good condition. Similarly, gear cutting machines and heavy duty machinery which is forced to the limit in production can only be expected to do accurate work when there is a definite schedule of inspection to detect wear and abuse before it becomes pronounced or breakdown results. Material handling equipment is taking the place of hand labor more and more. This considerably adds to the work of the maintenance division, as much of the material handling equipment requires frequent inspection if continuous operation is to be expected. For example, certain of the mechanical parts of overhead travelling cranes are subject to severe service and wear. These may have to be examined daily, as wear past a certain point affects the safe operation of the crane. With daily inspection wear can be noted and repairs made before the condition of the worn part gets past the point of safety of operation. Close inspection and prompt attention should likewise be given to coal and ash handling equipment, an almost indispensable part of the equipment of the modern boiler room. Such equipment is subject to grit and dust and unless the bearings are properly lubricated and maintained they quickly wear out. Likewise, power transmission equipment should be subject to rigid and frequent inspection. If the belt is too loose, the power required will not be delivered to the machine; if the belt is too tight, the bearings will become worn and there will be friction. If the couplings on a line shaft become loosened, the shaft will be thrown out of line. Regular inspection and tightening tend to prevent any such occurrence.

Inspection to find the incipient failure of machinery and equipment and the correction of defects before they become pronounced and costly, are duties of the maintenance division which, if faithfully performed, make the division pay for itself many times over in the course of a year. Prompt and efficient action in times of emergency attract the attention of the management and cause it to recognize the value of the maintenance division, but the quiet everyday routine of inspection and correction, while not attracting attention, is nevertheless one of the big items in keeping the operation of the plant on the

right side of the ledger by averting costly breakdowns and production delays.

6. *Keep tickler records of schedules of inspection.* In order to insure adequate attention for all machinery and equipment, a tickler file should be kept so that each day it will be known definitely just what machinery and equipment should be inspected that day. If this is not done, sooner or later some piece of machinery or equipment fails due to lack of maintenance, and there is the usual "passing the buck" as to who is responsible.

7. *Make repairs or replacements as shown necessary by the inspection records.* The inspector each day makes a written report stating just what machinery and equipment needs attention. Those requiring immediate attention are so marked. Those requiring attention but not urgently are so indicated by stating the approximate rate of wear or the approximate date by which the repairs should have been made. This permits of planning and scheduling of repairs, so as to attend to them at times that will cause least confusion in the shop and when the work can be done most economically.

Minor repairs and adjustments are made at the time of inspection. For example, in inspecting overhead material handling equipment, the inspector would naturally tighten any bolts or nuts requiring tightening at the time of inspection rather than to report the need of tightening and necessitate having another man go over the work again.

Small machines and pieces of equipment ordinarily are brought to the repair department as facilities are there for doing the work. Larger machines must, of necessity, be repaired in the shop where they are located. As the repair of such machines adds to the confusion of the shop it is customary to rush the job by putting on as large a force of repair men as can work together efficiently, and by doing as much of the work as possible over the week-end or at night.

8. *Make reports to the head of the operating division and to the head of the production division as to needed repairs and replacements and the date upon which work on them will be started.* Possible delays to production must be reduced to a minimum and yet necessary repairs must be made or equipment may be seriously worn or abused. Close cooperation between the operating division, the maintenance division and the production division is essential. In scheduling repair work, the head of the maintenance division should confer with the

head of the operating division to see whether the date upon which he plans to begin certain maintenance work suits the convenience of the operating men. The head of the operating division and the production division will want to know not only the date upon which repairs will begin, but also the date on which the machine or piece of equipment will be back in production. A temporary change in the routing of work during that period may be necessary. In a busy season when the plant is rushed to meet promised deliveries, it may be advisable to postpone repair work on an important machine for several weeks, even though it may ultimately increase maintenance cost on that machine. Every plant is looking for maximum production at minimum cost. Maintenance work is one of the services employed to meet that end and the head of the maintenance division must conduct the work of his division always with that thought in mind.

9. *Make estimates on all maintenance work* costing more than a certain stipulated amount, above which no maintenance work can be undertaken until estimates are made and approved by the proper authority. The making of certain emergency repairs may be an exception to this rule.

In insuring that proper plans are made, in every case where the estimated cost of material and labor on any single undertaking is over a stated amount, it is advisable to require that a sketch or a blueprint and a bill of materials be made and this be approved before the work is undertaken. This serves several purposes. First, it insures careful planning; second, it shows the works manager the methods and materials that it has been planned to use and gives him an opportunity of suggesting a better method or more suitable material; and third, it permits consideration of whether the plan as outlined is in agreement with the maintenance policy of the company.

If the estimate for the repair of a given machine or piece of equipment is any considerable amount, it is advisable to calculate whether it would be more economical to purchase new than to repair the old. Improvements in design are continually being made. A new machine of improved design may produce a greater volume or a product of better quality. This saving of labor or improvement in quality may be of such importance that, together with the expense of repair, it may decide the question in favor of buying new. Another factor is: what will be the length of life of the repaired equipment

compared with similar new equipment? Some equipment after being repaired is practically as good as new. The operation of other equipment no matter how carefully it is repaired is not so satisfactory after it has been in use for any length of time.

Some concerns replace their equipment when the repair cost per year exceeds a certain percentage of the cost of new equipment, say 20% to 25%. No rigid rule can be given, the question of replacement or repair depending upon the comparative life of the repaired machine or equipment, the use to which it is expected to be put, the improvements that have been made in the new, and the financial condition of the company. For example, if there is a question of how long the present product will be continued in production and of whether that type of machine or equipment will be used in the production of a subsequent product, it would probably be advisable to repair the old even though the repair cost may come as high as perhaps 40% or 50% of the price of the new.

10. *Suggest changes in design of machinery and equipment* to eliminate excess wear and to reduce the number of repairs and adjustments. For example, if bearings on a belt conveyor are in an out-of-the-way place or a place where it is hard to get at, it is advisable to install ball or roller bearings in place of plain bearings. Ball or roller bearings do not require greasing or oiling as often as ordinary bearings, and, in addition, effect a saving in power by reducing the friction load.

When a machine is taken down for repairs, the maintenance men may find that if the gears were made of steel rather than of cast iron the machine would not have broken down, or they may find that the failure of the machine was due to a poor design of a part or the use of cheap material in construction. In such a case they may alter the design or use a better grade of material in making the new part and notify the engineering department or the tool and equipment section accordingly.

11. *Disseminate information in regard to the care and operation of machinery and equipment.* Many breakdowns of machinery and failures of equipment are due to carelessness or lack of knowledge on the part of the operator. Such conditions can frequently be overcome by educating the workers to the proper method, and by establishing a basis of mutual cooperation and friendliness between the foreman, the workers and the maintenance men.

In some instances where wear or breakdown of a machine is due to improper design of a part of the machine, it may be advisable to substitute a more substantial or better designed part. In other cases such a course may not be practical. It is necessary to overcome the difficulty by working out a special method of operation and teaching this method to the operator, explaining to him the reason for the use of the particular method. When a worker is approached in the proper manner it is found almost invariably that he is very willing to cooperate in every respect and that he readily appreciates the need for the special method.

Correct lubrication prevents undue wear and reduces power losses due to friction, thereby increasing economy of operation. The operator of a machine is responsible for the lubrication of that machine. The maintenance division, however, is responsible for seeing that all machines are properly lubricated at all times. Close cooperation, therefore, is essential between the foremen and the maintenance men in charge of lubrication. The maintenance men, when on a repair job, can often tell the real cause of the breakdown or excessive wear. If from any of the above or other preventable causes this information and the remedy should be passed on to those in charge to be used constructively. In this way better service and longer life are secured from the equipment.

12. *Keep on hand readily accessible a sufficient stock of materials, repair parts and tools to take care of emergency repairs and routine maintenance work.* Standardization in this respect has many advantages. It eliminates needless variety, thus reducing inventories and saves time and effort in making repairs and adjustments, due to familiarity in handling the standard articles.

A study of maintenance stockroom records shows how many of each tool or part, and how much of each kind of material should be kept in stock. Spare parts should be available for all important equipment and for bearings and other quick wearing parts. A point in maintenance work which appears small but which is well worthy of attention is the need of selection of the correct materials for cleaning windows, walls, floors, etc. Large quantities are used in the course of a year and worthwhile economies result from their intelligent selection. It is not only economy in cost of materials that is involved, but of even greater importance, economy in use, through savings of labor.

As many of the materials and supplies are peculiar to the needs of the maintenance division, it is advisable to maintain a separate storeroom. While materials and supplies used must be accounted for, it does not always pay to account separately for each small lot of materials or supplies issued to the maintenance employees. The accounting for each cake of soap or pound of waste would cost more than the supplies themselves.

13. *Timekeeping, costing and records.* The efficient conduct of the power and maintenance division requires that the division have in its files record of the location of every important feature of the plant, together with all other necessary information covering the plant and its equipment. The following are among the permanent records which always should be readily accessible:

(a) Maps (B/P) of grounds showing extent of property, location of buildings, underground piping, surface and overhead service systems.

(b) Plans of each building and records of cost of maintenance.

(c) Record of all machinery and equipment in each building and their maintenance cost. Each piece of machinery or equipment should be given a number and a card record kept showing just what repairs were made, when they were made, at what cost, etc. Such records aid materially in determining the advisability of scrapping a machine or a piece of equipment when the costs of maintenance begin to get high. They serve as a guide in standardizing equipment and in purchasing as they point out the equipment which is cheapest in the long run. In addition, they are a valuable guide as to the care (particularly as to which bearings and parts), that should be given to keep a machine or piece of equipment operating efficiently. This will lead to systematic and periodic inspection as a preventative measure.

(d) Drawings and specifications of machines and equipment with list of parts and catalogue numbers for use in replacements.

(e) Records of machinery and equipment to which special attention should be given either because of its importance in the "key" process or because of the necessity for its continuous use.

(f) Layout of shop transportation facilities. (Industrial railways, monorail, etc.)

(g) Blueprints of all service systems. (Heat, light, power, steam,

ventilation, gas, compressed air, fire fighting equipment and facilities.)

(h) Record of all belts in operation. A complete record of all belts in the factory, repairs and replacements, enables those in charge of belt maintenance to decide the type and size of belt best suited for each purpose, and the proper treatment for each belt. It also aids in detecting any unusual operating conditions detrimental to the belting. In large plants it pays to have men to do nothing but specify and care for belts. With the rapid increase in the use of belt conveyors in material handling, belting, always an important item, has taken on an added significance. Each installation should be carefully studied to select the belt that will give best service and longest wear. Belting is a large item of expense. Belt failures are annoying and expensive. It pays to study the question, to standardize wherever possible, and to buy a high grade of the type needed.

(i) Stock record inventories of repair parts, materials, tools and supplies.

(j) Record of inspection (date, name of the inspector, parts inspected, results, etc.) of all machines, equipment, buildings, and so on, together with record of adjustment, repairs and costs.

Works Engineer: Qualifications and Duties.—The head of the power and maintenance division—the works engineer, plant or maintenance engineer as he is often called—must have a good technical knowledge and training and a broad experience with "men and means." He must be cool and collected, have foresight, be diplomatic, resourceful and a leader. In addition, he must have those other executive qualifications necessary in order to organize properly and manage his division so as to fully cooperate with other departments and divisions and render prompt and adequate service.

The duties of the works engineer are many and varied. It is his responsibility to see that the plant is kept at all times as an efficient working machine. This necessitates that he build up and maintain an organization to do the work and that he supply the plans and materials so that the work can be done promptly, economically and with no undue confusion.

Figure 72 shows a chart illustrating a typical power and maintenance division in an average medium-sized manufacturing plant. The items on the chart are self-explanatory. Usually there are several

foremen, each in charge of one or more phases of maintenance work. For example, if the volume of work demands, there may be a foreman in charge of all millwright work. Under his direct supervision would come the installation or moving of machinery and equipment

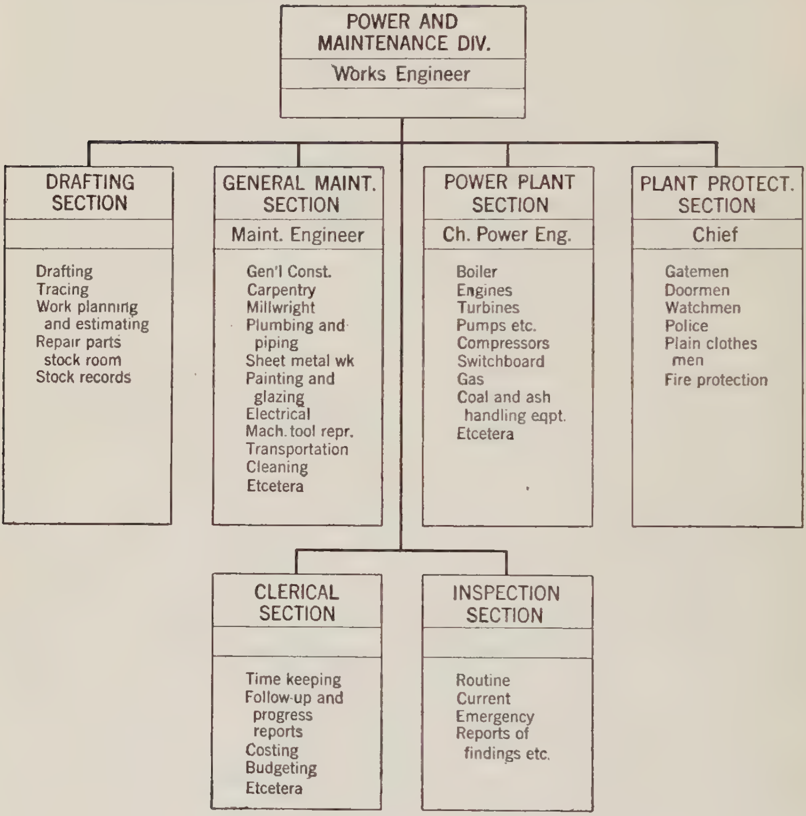


Figure 72. Chart of Power and Maintenance Division

and the attendant transmission equipment, the repair of machinery, and miscellaneous work along these lines.

Planning and Scheduling of Repairs.—Planning and scheduling of maintenance work is essential if delays to production are to be kept down to a minimum and the work on the various maintenance jobs is to be coordinated. To be effective the mechanism should be

kept as simple as possible. Certain maintenance work, such as that necessary for keeping the plant in a sanitary condition, namely, the sweeping of floors, cleansing of washrooms, washing of windows, etc., can be readily planned and controlled by specifying how many times a week or month each class of work must be performed, by issuing standard-practice instructions to cover the method of doing the work, and by supervision and inspection to see that the work is being done and that instructions are being followed.

Other maintenance work such as general plant maintenance (painting and general upkeep of buildings, and grounds, etc.), and repair of machinery and equipment, presents a more complicated problem due to the nature of the maintenance work involved and the varying intervals of time at which attention is required. It should be known at all times just what maintenance jobs are to be done and the urgency of each. With such a list and knowing the available man power, jobs can be scheduled accordingly. In planning maintenance schedules certain influencing factors must be taken into consideration. Chief among these are the following:

1. Emergency jobs must take precedence over other repair jobs.

2. Machinery should be overhauled when the machinery is least needed for production purposes. In this way production will be interrupted as little as possible.

3. Certain repairs call for special materials or parts which have to be ordered and time allowed for their delivery. While a well-stocked maintenance storeroom tends to eliminate such delays to a great extent, there are conditions under which it would not pay to stock certain parts or materials. As brought out in Chapter XVI in the discussion of material control, care must be exercised or too great a proportion of the capital will become tied up in inventories.

4. The same repair tools and equipment may be required on two repair jobs. As such equipment is frequently costly, it does not always pay to have duplicates, therefore, one job must be postponed until the other job is completed.

5. It is very difficult to calculate the exact time a repair job will take. Interruptions due to unexpected difficulties, additional repairs needed, emergency jobs which cause the repair men to leave the job for a time, etc., all tend to lengthen the time required and allowances must be made.

Work Order.—The inspector, after inspecting a machine or piece of equipment and making any adjustments and minor repairs necessary, sends in a report similar to the one shown in Figure 73. This report or work order specifies what work is to be done, the date upon which work should be started, the date upon which work should be completed and the estimated cost. Space is provided for entering the actual cost and for the signature of the head of the maintenance section. The former is necessary for accounting purposes and to judge the accuracy of the estimate made. When the estimated cost is over a specified amount, after the work order has been approved by the

WORK ORDER	**Date**		
Location **Machine**	**COST**		
Work to be Performed		ESTIMATE	ACTUAL
	Material		
	Labor		
	TOTAL		
	Estimate by		
	Charge to		
	To be Performed by		
	Date Set for Completion		
	Date Started		
	Date Completed		
	Written by		
	O K'd by		

Figure 73. Inspection Report or Work Order

maintenance engineer, a sketch and bill of material, with a formal estimate of cost, must be approved by the works engineer and any other designated persons before the job can be undertaken. Preparing the latter only after approval of the work order by the maintenance engineer, prevents a lot of work being done in calculating exact costs for jobs which may never be done.

Requiring the approval of the maintenance engineer for all except minor repair work done at the time of inspection serves several purposes: (1) the inspector is more careful in the recommendations he makes, knowing that they will be checked by his chief; (2) any information needed for making the repairs but which has been left out by the inspector can be added by the maintenance engineer or

returned to the inspector for correction before approval; (3) it prevents repairs being made which the maintenance engineer does not feel are justified or advisable. It may be that the maintenance engineer feels that the condition of the machine does not warrant the expense of the repairs or that the repairs are not really needed, the machine operating well enough to suit production purposes as it is. Under such conditions he would not approve the recommendation.

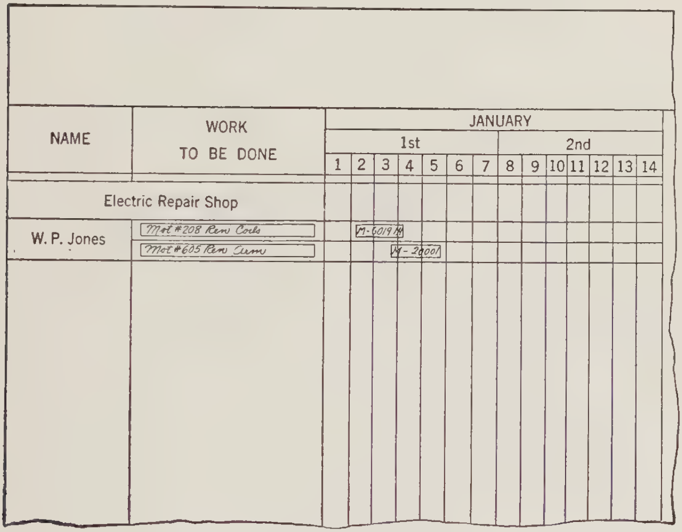


Figure 74. Control Board Used for Scheduling Maintenance Work

From John C. Somers, "Schedule Methods for Plant Maintenance," *Manufacturing Industries,* June, 1927, page 451.

Under the heading "charge to" should be inserted the account number to which the cost of the work should be charged and a symbol to indicate whether it should be charged as maintenance expense (repair or maintenance), or to fixed capital (construction work such as a new shed or additional lockers and washroom, etc.)

Control Board.—Scheduling and control of repairs can best be done by means of a control board to show at all times the jobs the repair men are working on, the jobs ahead of them, and how much current time is available for new work.

The control board, as shown in Figure 74, is divided into sections,

a section being set aside for each class of repair men. "In this way electrical maintenance would have one section, millwrights another, carpenters another, etc. By having definite working periods, available capacity can always be seen and each new job can be fitted into the existing program. The name of the workman would go in the column 'Name'; under 'Work to be Done' would appear the function of work (for example, 'rewind field coils'); for the dates would be given the time allowance indicated by a small card which would be labeled by work order number and, in case of a fractional day, by the number of hours. This card would be inserted between two horizontal wires directly opposite the 'Name' and 'Work to be Done.' In a larger organization it would be sometimes advisable to replace the name of the worker with that of a group of workers or possibly a foreman." [4]

As soon as the repair men finish their present job, the corresponding card on the control board is removed and the men are given their time tickets for the next job scheduled on the control board, together with instructions for the job as drawn up by the inspector. These detailed instructions act as guides as to the steps to take and the method of doing the job. Many maintenance jobs can be standardized, but in other jobs conditions may vary. A machine when torn down may present problems different from what appeared to the inspector in studying it before it was dismantled, and again, the repair men being experts in their line may improve on the method outlined by him.

When a job is finished or a workman finishes the particular part of a job assigned to him, he turns in his time ticket for that job and receives his time ticket for the next job scheduled for him.

[4] John C. Somers, "Schedule Methods for Plant Maintenance," *Manufacturing Industries,* June, 1927, p. 451.

CHAPTER XXII

INSPECTION DIVISION

Function and Scope of the Inspection Division.—The reputation of a concern and the degree of success attained depends to a considerable extent upon the quality of its product. A company that merits a reputation for giving good, honest value for the money received has an invaluable asset. The engineering department in designing the product and drawing up the specifications sets a standard of quality. The operating division—the shops—actually make or fabricate the product according to these drawings and specifications. It is the function of the inspection division to see that the quality of the product turned out is at all times up to the standard set.

The work of the inspection division is more than inspection of the finished product and rejection of that which is not up to standard. It covers preventative measures which tend to eliminate the causes of rejection. The field of inspection includes:

1. Inpection of All Purchased Materials, Parts and Supplies.—Such inspection insures that all accepted purchases are up to the specifications under which they were purchased. This serves to prevent loss due to accepting short count or inferior quality, as well as loss due to labor and machine time being expended upon inferior materials and defective parts which later would have to be scrapped, or if used would result in the fabrication of a product of a quality below the company standard, or one upon which an undue amount of time and labor had to be spent. As the product can be no better than the materials and parts which enter into it, this function of the inspection division is more important than is ordinarily realized.

In some cases, visual examination may be sufficient for the inspection of materials and purchased parts and supplies. In other instances, inspection may involve the maintenance of an extensive laboratory where chemical, mechanical, electrical or metallurgical tests can be made. Small concerns, and those of the larger concerns where the volume of such work does not warrant the cost of main-

taining a company laboratory, make use of commercial testing laboratories. A rather unusual and interesting test of raw material is one described under the heading of "How Railway Wheels are Made in Australia," in the Midvale Safety Bulletin.[1] "Newport Workshops, where Victoria's railway wheels are assembled, receives the tyres in practically a finished state, but thorough tensile tests are necessary. . . . Ordinary truck tyres must withstand a tensile test of forty-five tons to the square inch. Fifty-two tons is demanded of tyres for electric rolling stock.

"A severe 'drop' test is also carried out. The tyre is thrust under a guillotine-like structure. Pinioned there, it is dealt a crushing blow by a ton weight which thuds down from a distance of twenty feet. The effect of the blow is noted and comparisons made with the specification of the materials ordered."

2. Inspection of Work During Process.—If inspection is made of work at the various stages in the manufacturing process, errors or defects can be found and corrected or the part or material reworked or scrapped, as the case demands. This not only prevents spending additional labor and machine time upon defective or poor workmanship parts or materials but in assembly industries frequently prevents serious delays in assembly. For example, in the manufacture of camshafts in the Packard Motor Car Company, the raw material is purchased and tested in various ways. The material is then forged and the shafts are heat treated. After the heat treatment, the camshaft is placed in a pickling solution to dissolve the scale which has formed during the forging operation. This process aids in the inspection of the camshaft for imperfections either in the steel or in the forging. They are also inspected for length and location of cams and to see that there is sufficient material for finishing.

Under mass production, interchangeability of parts in assembled products is essential. In the past, interchangeability of parts was rarely if ever found. Parts when started in production were designated as being parts for a specific finished product. Even at that, when the time came for finished assembly, discrepancies were almost invariably found. Parts had to be filed down to the correct dimensions or some similar adjustment had to be made. Such corrections involved annoying delays and materially increased costs. Moreover, manufac-

[1] The Midvale Steel Company, Philadelphia, Pa., May, 1927.

turing costs for a product could not be estimated with any degree of accuracy as costs varied with the particular product. Two products apparently identical when completed might have a wide variation in cost. Improvements in machine tools, measuring instruments, and production control methods have changed such conditions. With the accuracy of our present machine tools and the variety and accuracy of gages and other measuring instruments which can be had for every conceivable need, there is no excuse for work not being up to standard and parts not being interchangeable.

A safe rule always is to inspect carefully the first few parts produced after a new set-up so as to be sure that the machine is working properly and that the operator understands instructions and is following them closely. If this is not done a quantity of spoiled work may accumulate and considerable loss be incurred before the defective work is discovered. In many cases, the operator may be blamed, whereas the fault lies with the machine, or a defective gage with which he is working, or the lack of proper instructions. Inspection at the outset would discover the defective work, so that the cause of spoilage could be recognized and remedied immediately. After this initial inspection, inspection should be made of work in process from time to time to insure that the work is being correctly done. The length of interval between inspection and the extent to which inspection is carried depend upon local conditions.

All defective work, commonly spoken of as rejects, should be disposed of at once so as to prevent their getting mixed with good work. Rejected work should be sorted over to determine how best to make profitable use of it. Some parts may require only a little additional machining or an operation or two which is lacking. In this case, they would probably be returned to the operator who did the work. Others may be in such a condition that they should be sent to the salvage section. (For a discussion of the work of the salvage division see Chapter XXXIII on industrial waste.) In the hands of competent mechanics the salvage section can be made quite a profitable undertaking. Many parts that would otherwise have to be scrapped can be utilized. The repair mechanics know what defects to look for and they become unusually skilled in remedying them. Another value of the repair shop and one which should be given due consideration lies in the fact that it relieves the confusion arising when an appreciable

number of rejects are returned to the shop. Repairs on defective work interfere with routine production. Rejects get mixed with good work and are inspected and rejected and returned for repair, then inspected again, and so on, all around in the circle. They can be controlled if they are suitably tagged and their movements are carefully restricted, but at best they are a source of annoyance and confusion which should be gotten rid of if possible. Where it is practicable to maintain a separate repair shop, that very nicely takes care of the problem. After being repaired the rejects are carefully inspected and accepted if up to standard.

Inspection does more than safeguard quality. Inspection keeps track of quantities of materials or parts which pass from operation to operation. This serves several purposes. It guards against the number of finished parts falling below the number required. If at any time the number of accepted parts falls below a specified number, a change can be made in the production schedule to make up for the deficiency. In those shops where the workers are on a piece-work basis or are working under an incentive system providing a bonus or premium, inspections for both quantity and quality are necessary as a basis of payment, payment being made for the amount of good work produced.

3. Final Inspection of the Finished Product.—In practically every concern, the finished product is examined before it is put in stock or shipped. Even in those concerns where there is little or no inspection during work in process, with the exception of that done by the foreman in charge, there is almost invariably a final inspection of some sort. In some concerns, products which do not fully meet the standard requirements are marked and sold as "seconds." Other concerns dispose of their products which do not come fully up to standard at a lower price under another name or trademark, being careful, however, not to do anything which might detract from the reputation of their standard product.

4. Reports on Rejects and the Causes for Rejection.—The main function of the inspection division is to inspect and count, pass or reject, and report its findings. Those in charge of the inspection division are in position to render valuable aid to the management if they look upon their duties in a broad light. By analyzing the causes

of failure and giving constructive criticism, the inspectors can furnish the management with information which they might not otherwise be able to secure. Inspectors are in a position peculiar to themselves. They are in close touch with all that goes on in the shop and yet they are not operating men. They are, therefore, in a position to know exact conditions and to view them in an impartial light. When there is an increase in spoilage or a slowing down of output in one of the operating centers, the inspectors, due to their everyday work, readily detect the difficulty, often even before it has become appreciable enough to be noticed by the foreman in charge.

INSPECTION TICKET

Model	Piece No.	Dept. No.	Date

Order No.............**Emp. Name**..**No.**............

Name of Piece..

....

Name of Operation..

No. of Operation...

No. Rejected { **Stock Defective** ....
Labor Defective...

No. Received..................**No. Accepted**..................**No. Returned**..................

Remarks..

....

....**Inspector**

Figure 75. Inspection Ticket

Some concerns furnish their inspectors with a "trouble report" blank on which space is provided for the inspector to report any difficulty to his chief and to note on it what he "knows" or "thinks" is the cause, making a clear distinction between the two. The chief, if he feels the matter warrants it, can then pass on the information to the proper party. This must not be misconstrued to mean that the inspector plays detective and goes around looking for trouble and for someone on whom to fix the blame. Inspectors are to help remedy causes of trouble. The reports are submitted with that thought in

mind and the criticism if any is from a constructive and unbiased point of view.

Place of the Inspection Division.—The inspection division should operate as a separate unit independent of any shop control. A decided advantage is gained in placing the operating division and the inspection division as separate units, but reporting to the same head. He can then correlate the work of both divisions and promote healthful cooperation between them.

When the inspection division is under the superintendent or when there is no separate inspection division as such or, if there is, its efforts are confined to final inspection, quality of product generally suffers. When the foremen and their assistants are responsible for all inspection done during work in process, the result is that in many, if not most cases, work is passed which should have been rejected. In the average plant the foremen are constantly being pressed for greater volume of output. In their efforts for quantity they are very likely to ease up on application of standards of quality. Similarly, if the chief inspector reports to the superintendent. Under pressure for quantity the superintendent, who after all is only human, is likely to question when there are a large number of rejections whether inspection is not a little too close. The chief inspector, anxious to please or fearing to displease the "boss," agrees with him and passes goods which do not come up to the standards that have been set.

Some advocate that the chief inspector should report direct to the general manager, others that he should report to the head of the engineering department. The first method of organization is advisable for those concerns which do not have a factory manager or director of manufacturing, but for those larger concerns which have a manufacturing executive, the gap is too big. The general manager in a large concern is interested in the larger and more general problems of the company. He is occupied with the coordination of the functions of sales, production, engineering and finance. He has not the time to devote to the problems of inspection, even should he be so inclined. If inspection is subordinate to engineering, failure of the product to come up to standard due to faulty engineering may be covered up or attributed to some other cause. Inspection, to be effective, needs to be away from all influences which would consciously

or unconsciously tend to wean the inspector away from a strict observation of his duty.

Cooperation of Operating Men and Inspectors.—The manufacturing executive, having full charge of all manufacturing functions, is in a position to bring about the necessary cooperation between the inspection and operating divisions. The operating men and the inspectors under average circumstances are only too likely to look upon each other as friendly enemies, and often not so very friendly at that. Production cannot help but reflect such an unfortunate condition. Inspection alone cannot control quality nor take the place of good workmanship. The operating men are responsible for the quality of the goods they produce. The inspectors are responsible for detecting failures and preventing losses due to additional work being put upon materials or parts which are not up to standard or to the sale of a product below standard. Both operating men and inspectors deal with quality but from a different standpoint. A common meeting ground, an appreciation of each other's problems, and a feeling of friendly cooperation is essential between them.

If an inspector finds that the quality of the output of a given machine is below standard then that machine should be immediately stopped. Unless such a situation is properly handled, friction is bound to arise. The operator of the machine may be blameless. The fault may lie with his machine. If he is on piece-work, or working under an incentive system with a bonus for quantity produced, he resents being deprived of his opportunity to work. His foreman may side with him, feeling the product of the machine is good enough and that the fault is with the inspector, who is what the foreman calls an old crab or a fussy crank. This is one of the instances where the wisdom is shown of putting inspection and operation subordinate to the same person. He defines the procedure to be followed in such cases and is himself the final judge. By making such problems a matter of routine, he avoids friction. Both operating men and inspectors know under just what circumstances machines may be stopped and when they may be put back into production. The problem then is no longer a personal matter. When, in addition, a system is developed providing a suitable reward for quality, the connection between operation and inspection becomes still closer, and the operators even to some extent become their own inspectors

Quality becomes to them an important factor. They no longer want to turn out quantity regardless of quality. Their best interests lie in detecting causes of failure at the very outset and of preventing their recurrence. The inspectors, therefore, are looked upon as the friend of the operating men and both work for the common end of producing goods of standard quality.

Chief Inspector: Qualifications and Duties.—The chief inspector of a large industrial concern must be a good practical man of considerable ability. He must be thoroughly familiar with the practice and standards of the industry and with the shop processes and standards of the particular plant. In an assembly industry, he should be familiar with all parts of the product, their function, how they work together and are assembled.

He must be thoroughly familiar with the use of testing-machines, gages, measuring instruments, etc., and with the latest methods and practice as used in the inspection field.

From the reports of rejections made by his inspectors and from his own personal investigations, he should be able to locate the underlying troubles in production and place the necessary constructive information before the proper person.

He must have executive ability so as to be able to conduct efficiently the work of his division and to direct and control his organization, even though the personnel is scattered throughout the entire plant. His aim is to build up and maintain an organization which will be of greatest possible service—men, who with the first slowing down, spoilage or other sign of production troubles, will immediately inform the man in charge and serve to avert further trouble.

Qualifications for Inspectors.—The qualifications for inspectors depend upon the nature of the work involved. The personnel of the inspection division, due to diversification in the manufacturing processes, may be composed of men and women of varying experience and education ranging from men of technical knowledge down to the average apprentice. The characteristics of the personnel required in the various kinds of inspection work likewise vary. For certain kinds of work in a central inspection room, the main requirements may be the ability to do exactly as one is told and the possession of good eyesight, or a well-developed sense of touch or perhaps keen hearing. For an inspector on the floor in a machine shop coming in direct

contact with the operators, the prime requisite would probably be trustworthiness, ability "to get along" with men and familiarity with the parts he handles and with the testing instruments he must use. As in the ordinary case the latter could be readily taught to the person of average intelligence; a trustworthy man who is a first-class machinist and a person of good character would probably admirably fit the need.

(Courtesy of Lockwood, Greene & Co., Boston, Mass.)

Figure 76. Ideal Working Conditions for Girls with Keen Eyesight and a Highly Developed Sense of Touch. Here the silk is given its final inspection by girls trained to detect the slightest imperfection, and after it leaves them it is ready to be packed for the market. American Bimberg Plant, Elizabethton, Tenn.

Inspectors who come in contact with operating men, such as floor inspectors and the heads of central inspection cribs, must be men of tact, good judgment and practical experience. They must be men who are fair and square in their judgment, and firm in their decisions; men who fully realize the responsibility of their position and the authority vested in them but do not abuse it.

Setting of Standards Prerequisite to Inspection.—Unless definite standards are established, intelligent inspection cannot be

realized. Where acceptance or rejection depends to a considerable extent upon individual judgment, uniformity of quality cannot be achieved. It is not at all an uncommon occurrence to have the opinion of inspectors of equal ability and judgment vary over whether a part or material should be accepted or rejected. It has been said that if there were a hundred parts inspected by a dozen competent inspectors, each working irrespective of the other, in the end there would hardly be found a dozen parts which had not been rejected on some technicality by at least one inspector. To eliminate the necessity of depending upon individual judgment alone, definite standards must be established. The inspector is called upon to exercise judgment, but it is judgment within certain limits prescribed for him.

As brought out in the discussion of the work of the engineering department (Chapter XIV) that department sets the standards of quality that are desired. As absolute accuracy can rarely if ever be attained in practice, the engineering department, after working out the ideal standard, indicates how far the product may vary from the standard set. This relieves the inspectors from having to decide continually whether or not a finished part is close enough to the exact dimensions to allow it to pass inspection. Some industrial men advocate that, even with the allowed variations specified by the engineering department, the inspector should be allowed to exercise his judgment in their practical application, leaving it up to the inspector to decide whether a part should be accepted or rejected when the work falls without but close to the limits set. This policy if carried very far is fraught with difficulties. Quality always tends to slip away.

The engineering department is responsible for setting standards of quality. If decision as to deviation from these standards is left to the judgment of the inspectors, the engineering department is released from responsibility, should the product as passed be below standard. In some instances it may be perfectly permissible to deviate, in other instances the deviation of a quarter of a thousandth of an inch may affect the assembly of the part with a mating part, or again, the accepted part may permit of assembly but may shorten the life of the product when put in service. If under working conditions it is found that the limits are too close, the chief inspector should take up the matter through the proper channels and the engineering department can then best decide how to remedy the situation. Close cooperation between the engineering department and the inspection

division in the matter of standards and their application is essential if quality of product is to be safeguarded and production is to be facilitated. Limits set too close result in too many rejected parts or an unnecessarily large amount of rejected materials, seriously interfere with production and unduly increase costs. Limits that are not close enough result in poor work being accepted and the quality of the product lowered.

Testing Instruments.—Means must be provided for measuring the quality of work. In some instances comparisons must be made by sample, as there has not as yet been devised any instrument to measure the qualities covered, for example, odors (perfume industry) and taste (food products industry). Until recently color had to be similarly measured by sample, but there are now available color measuring instruments. Inspection by comparison with a sample, while a simple method is not an accurate one, as samples change in time, the changes usually being so slight as not to be perceptible. In consequence, the sample may be quite different from what it should be before the change is detected.

In contrast to the simple and inexpensive method of comparison with a sample is the method of using precision instruments, many of which are high-priced and some of which must be designed for a particular job. Micrometers, graduated so that readings can be obtained to one tenth of one thousandth (0.0001) of an inch, are in common use in the automobile industry. One example of precision is the fitting of the piston pin into the piston. Accuracy for certain parts in the Hudson Motor Car Company is held within one-quarter of one-thousandth of an inch. This is a standard of fineness far beyond the perceptive power of human senses. It is equivalent to one-tenth the thickness of a hair's breadth. Such accuracy, which is not uncommon in high-grade motor car manufacture, is attainable only through exceptional manufacturing facilities and modern inspection instruments of the most delicate sensitiveness. Figure 77 is a photograph of such inspection taken in the plant of the Packard Motor Car Company. In the same plant, the smoothness of finish of piston pins is inspected and tested by means of a radio amplifier. Similar inspections for minute variations in measurements are found in other industries, such as the watch industry and the industry for the production of scientific instruments and apparatus.

In those concerns where small parts are produced in quantity, fixed dimension or limit gages are used in many instances in place of adjustable precision gages. Figure 78 illustrates three forms of limit gages. The advantage derived from the use of limit gages is that the time consumed in testing and gaging is reduced to a minimum, and the accurate duplication of parts is insured. The two ends of the gage as shown in Figure 78-C are of different shape, thus furnish-

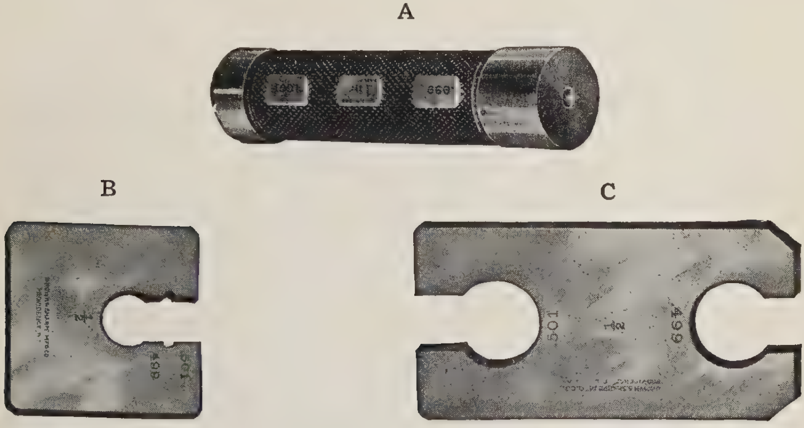
(Courtesy of Packard Motor Car Company, Detroit)

Figure 77. Inspection of Piston Pins for Size with an Instrument with which an Accuracy within .0001 inch Can Be Maintained

ing means of identifying the larger end from the smaller without reference to the size stamped on the gage. The gage shown in Figure 78-B is a very convenient form. Both sizes are contained between the jaws at one end of the gage; the large size, or maximum limit, is at the outer end of the jaws, and the small, or minimum limit, at the inner end. For other illustrations of limit gages see Figure 80.

Means must be provided for checking the accuracy of gages and other measuring instruments. An operator or inspector may think

he is doing accurate work, but his gage may be inaccurate. Inspection and testing instruments must be maintained at all times in as near a state of absolute accuracy as is possible to secure. This may involve checking for accuracy with master gages and instruments every day, and in some cases two or three times a day.



(Courtesy of Brown & Sharpe Mfg. Co., Providence, R. I.)

Figure 78. Limit Gages

Extent to Which Inspection Should Be Carried.—The extent to which inspection should be carried depends upon the nature of the product, the manufacturing processes, the skill of the workmen and the standard of quality set. Inspection should never be carried past the point of profitable returns. With high quality products depending primarily upon the skill of the worker, inspection would have to be carried to a high degree. In concerns using automatic machines to turn out a standard article, inspection would have to be made only at certain intervals, and then only an occasional article inspected as representative of the quantity turned out. In the same plant in different parts of the manufacturing process, inspection may have to be carried to different degrees. In an operation where error is very likely to occur or where the work of that operation decidedly influences or controls the subsequent operations, ordinarily each piece must be inspected during or after that operation. Other operations on the same part or other parts of the same product may require no inspection at all, or at the most only an occasional inspection.

As in all things, common sense is needed in determining just how

far inspection should be carried. The first question to be answered in any given case is what is desired to accomplish by that particular inspection. The next question is how the necessary inspection can be obtained in the most effective and most economical manner. In installing a system of inspection, the danger may lie in a tendency toward too much inspection as well as toward too little. In the latter case, quality is not adequately guarded and is likely to slip away. In the first case, the overzealousness of the inspection policy may not only greatly increase costs but may, in an extreme case, tie up production. Under ordinary working conditions it would be impossible to eliminate all but perfect work, and it is impractical even to try to closely approach such a condition. A middle course must be followed.

Methods of Inspection.—Inspection may be done in either of two ways.

1. *Inspection of each piece or portion, 100% inspection.* When the parts must be made with a high degree of accuracy or when the operation performed affects other operations which follow, 100% inspection is required. An example of 100% inspection is shown in Figure 79. At the left of the cut the rod is shown in a specially designed alignment gage with which it is possible to maintain an accuracy of 0.0005 of an inch. The scale in the center is used to see that the rods are within the required weight. At the right is shown a specially designed operating fixture which is used to determine whether or not the bushings have been pressed in tight enough, so that they will not work out.

2. *Inspection by sampling.* The selection of a piece or two or a portion or two at random and inspection of them as representative of the lot is called inspection by sampling. Sampling plays an important part in inspection work. It is an economical method, therefore it holds down costs of inspection. It permits of passing a whole lot at a time, thus it facilitates production. To have inspection by the sampling method effectual, certain precautions should be taken.

(a) Samples should be chosen from all parts of a lot in order to have the samples selected truly representative of the entire lot.

(b) When the sampling method is used, it is essential that inspection be made of the first parts turned out by a machine on a new set-up. While this is advisable in all cases, it is imperative when inspection is by the sampling method. The loss due to a defective part

is not restricted to the cost of that part but includes what may be a far greater loss, namely, that which results from the use of a defective part. When inspection is by sampling, the inspector may just happen to choose as his samples parts up to standard, while many of the other parts in the same lot may be below standard. A safe precaution is to see that the machine is working properly and turning out good work. If production is right to begin with, under a competent operator it will ordinarily continue to be good. This can be checked by periodic inspection of samples.

(Courtesy of Packard Motor Car Company)

Figure 79. Inspection of Connecting Rods

(c) If one or more samples are rejected, a number of additional samples should be inspected. If an appreciable number of samples are rejected, the entire lot should be rejected or each unit in the lot should be inspected. The course to follow in such a case would depend upon the value and type of the goods inspected.

(d) As ordinarily the unit value of goods inspected by the sampling method is comparatively low, the inspector may become

careless. It is well, therefore, to check the accuracy of the work of the inspectors at frequent intervals. A single screw, a nut or a bolt costs but a trifle. Because of the low cost an inspector may not think the nut, bolt or other small part is important enough to warrant a careful inspection. A check upon small rejected parts and upon accepted parts often pays.

Types of Inspection.—Inspection may be either of two types, *floor* inspection or *centralized* inspection.

Floor inspection covers inspection of the part or material at the machine or place of work. The extent of inspection may vary from a casual scanning of the work in process and an occasional inspection by the sampling method to an accurate and painstaking inspection using precision instruments. The chief advantages of floor inspection are that it reduces material handling and that it enables defects to be discovered shortly after they occur, and thus prevents additional labor or material being expended and wasted on the defective part.

Under centralized inspection, the finished work is carried to a special place set aside for the work of inspection. There may be one centralized inspection place to care for the needs of the entire plant, or, as in most cases, there may be a number of inspection places, each so located as to care for most conveniently the portion of the plant or group of machines it is to serve. The main advantages of centralized inspection include:

1. Less experienced and less skilled inspectors can be employed, as it is easier to supervise their efforts.

2. Inspection can be made more thorough and can be completed in less time. The work of inspection can be broken down farther and the advantages arising from division of labor can be more greatly realized.

3. Aids in control of materials. Accurate records can be readily kept of all materials received and from whom, their quality and to whom issued.

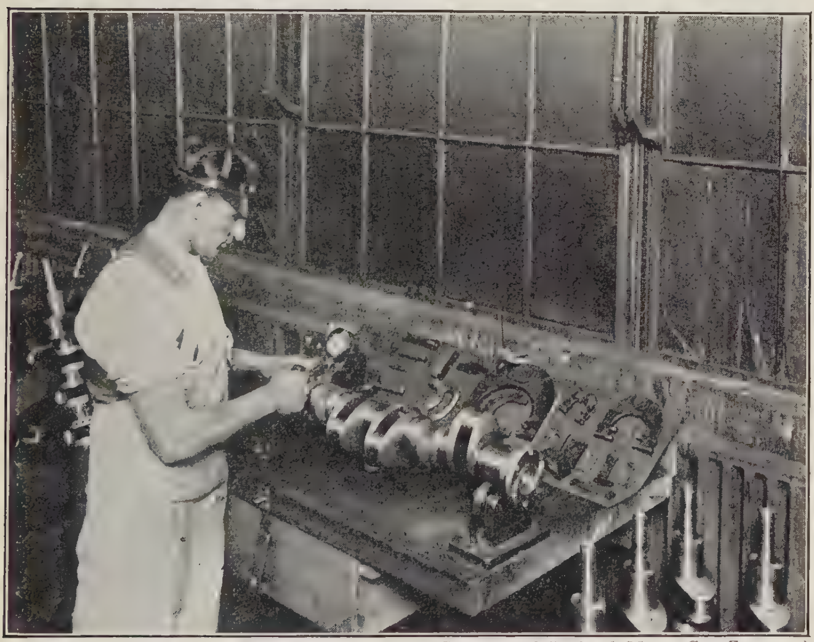
4. Less possibility of connivance, as inspectors and operators do not come in personal contact.

5. Shops can be kept in a more orderly condition, a factor in plant maintenance and in the morale of the working force.

6. Testing-machines and apparatus and various other inspection

facilities can be utilized. For example, a silent room is sometimes used. A silent room is a sound-proof compartment so constructed that even the slightest sound can be detected. Such a room is invaluable in testing quietness qualities, as for example the quietness of operation of rear axle assemblies for use in a motor car.

Centralized inspection, however, is not practical in some instances. For example, in progressive manufacturing where the work in process moves continuously from one operation direct to another, floor inspection is advisable. However, even in such cases, centralized



(Courtesy of Packard Motor Car Company)

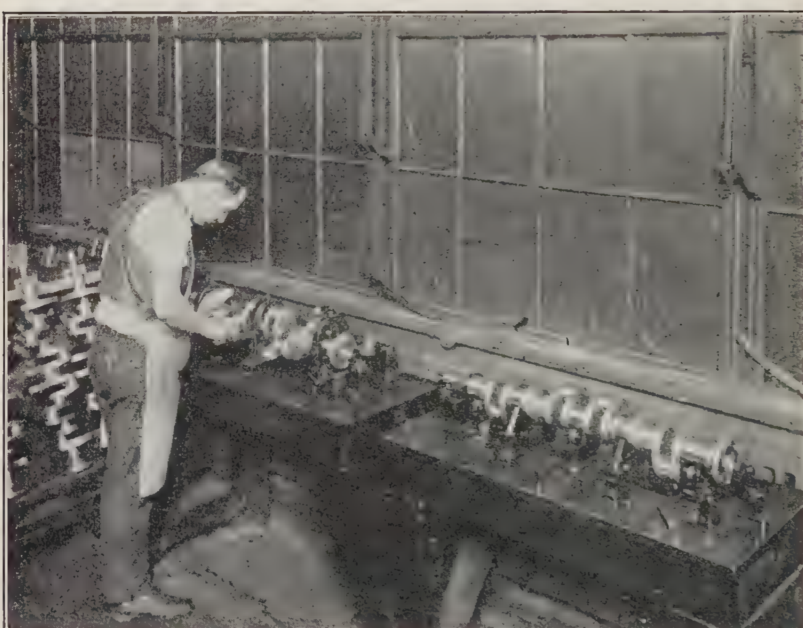
Figure 80. Checking the Size of the Main Bearing and Crank Pin Diameters

inspection just prior to sending the parts to finished stores is desirable. Again, where the work is bulky or heavy, centralized inspection would not be practical. In most plants both types of inspection are made use of.

Illustration of Inspection from Raw Material to Finished Product.—The following gives in sequence the inspection carried on

in the Packard Motor Car Company in the manufacture of crankshafts.

Samples of the steel are taken from a shipment and checked for carbon content by the combustion method, as well as for chemical analysis. These samples are also put through the micro-etching test, are heat treated to the required forging temperature, quenched and drawn. The proper hardness is recorded with a Brinnel instrument.



(Courtesy of Packard Motor Car Company)

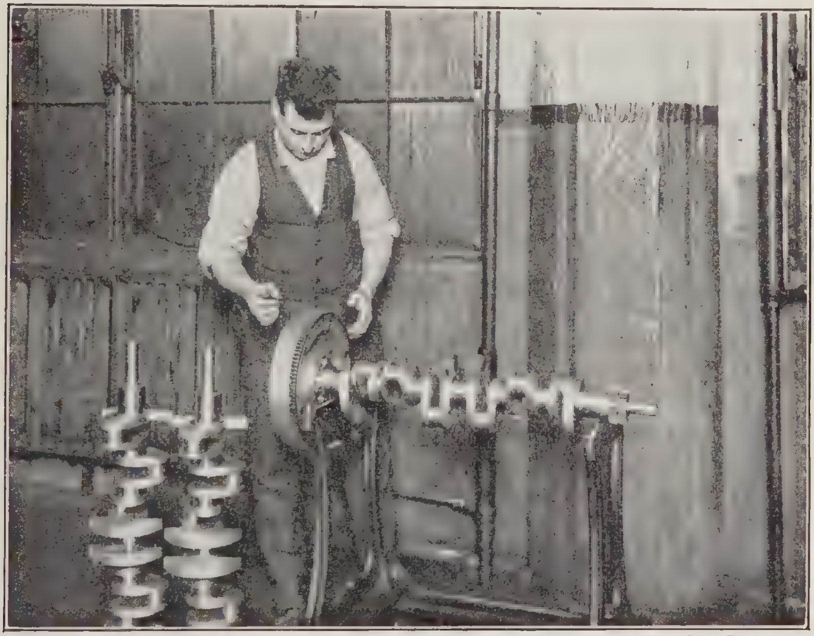
Figure 81. Checking the Position of the Pins and the Spacing

The pieces are prepared and subjected to a tensile test. After this test is completed, the remainder of the shipment is sent to the forge shop. Great care is exercised in heating these pieces for forging. They are put into a furnace automatically controlled and are forged. The shafts are gone over for defects, such as improper filling out of the dies, seams, etc.

The next operation is the hardening and tempering, which is very important. They are heated in an automatic continuous type

furnace to a normalizing temperature and are allowed to cool. They are again heated, quenched and drawn.

They are then carefully inspected for both forging defects, such as seams, pipes and low spots caused by the dies not filling out, and all dimensions are inspected by specially designed tools and fixtures and must show the proper hardness, which is recorded with a Brinnel instrument.



(Courtesy of Packard Motor Car Company)

Figure 82. Static Balancing of the Crank Shaft Assembled with Counter-weights and Flywheel

The shafts are completely machined and are inspected for each machine operation performed. (See Figure 80.)

Figure 80 shows the shaft suspended from the front and rear bearing, and the operator checking the size of the main bearing and crank pin diameters with an instrument with which it is possible to measure within 0.0001 of an inch. Other gages are also shown in this view for checking the diameter of flanges, diameter of oil throws, gage for location of oil throws, size of holes in flange for supporting

the clutch shaft, diameter of hub, keyways, crank and pin radii and also the length of pins and main bearings.

At the right of Figure 81 is the fixture for checking the position the pins should occupy with relation to each other. This gage also checks the spacing. With these gages it is possible to check within an accuracy of 0.0005 of an inch.

After this operation, the counterweights are carefully put in place, the shafts are dynamically balanced to a limit of ¼ ounce inches, and they are again inspected in a specially designed fixture with indicators that check the main bearings and flange in one setting. These must run true within 0.001 indicator reading. This is shown at the left of Figure 81.

The shafts are then put into a specially designed machine which hones the main bearing and crank-pins in the same setting, in one operation. This operation aids the inspector in checking for imperfections in the grind finish, such as chatter marks, roughness and taper. The shafts are again inspected for smoothness of finish and diameter of bearings.

Figure 82 shows the shaft after the counterweights and fly-wheel are assembled on a static balancing way.

CHAPTER XXIII

TOOL STORAGE AND CONTROL

Tool Control: Its Scope and Importance.—The quality of the work turned out and the cost of production depend to a considerable extent upon the suitability and quality of the tools used and the method of tool control in that particular plant. A first-class workman with the best of materials to work with cannot turn out a perfect product, nor can the product be turned out as economically if he is forced to use imperfect or unsuitable tools. Likewise, the time lost in obtaining the necessary tools when changing jobs is frequently an item in factory costs. Not only is the time of the operator lost, but expensive equipment stands idle, the production schedule is thrown out, and plant efficiency in general is lowered. The remedy for such conditions is adequate tool control with a suitable toolroom operated to the best possible advantage of all concerned.

Kinds of Tools.—The average person rarely appreciates what the term "tools" includes. When he hears the word, tool, he associates with it a hammer, a screw-driver or some other simple tool with which he comes in contact in his everyday life. He little realizes that in most plants tools comprise a large and very important part of the plant equipment. A tool is defined by the New Universities Dictionary as "any instrument of manual operation." In a plant, broadly speaking, there are four kinds of tools:

1. *Auxiliary tools.* That is, tools used in setting up or tearing down a machine (wrenches, hammers, screw-drivers, etc.).

2. *Holding tools.* (Jigs, fixtures, dogs, straps, T bolts, etc.) A fixture is a tool which is rigidly fastened to the table on the machine in order to locate and hold the work in proper position. A jig is similar to a fixture, except that it is free to move and that it guides the cutting tool. A dog is a special lathe clamp.

3. *Cutting tools.* (Drills, reamers, milling cutters, lathe and planer tools, forming tools, etc.)

4. *Measuring tools.* (Scales, gages, micrometers, calipers, etc.)

Essential Requirements of Tool Control.—As the aim of every tool system is to serve production, the system of tool control to be effective must be devised to meet the individual needs of the particular plant. This requires a thorough analysis of plant needs and considerable care and forethought in devising the system that will best meet those needs. If a tool control system when put in operation does not provide prompt and adequate tool service to the plant as a whole and to every shop in that plant, the system is lacking and should be studied, and the defective conditions when found should be promptly remedied. No one system of tool control is suited to the needs of industry or even to all plants in the same industry. Even in the same plant different shops may require different treatment of tool control in order to expedite tool service for the particular shop.

For the men working on the assembly line, the best plan may be to issue to each man a tool kit containing the tools he would ordinarily use. These are charged to the operator, and he retains them as long as they are in good condition and he remains in the employ of the company. In another shop in the same plant it might not be desirable to issue to the workmen the tools they require and allow them to keep the tools in their possession. To do so would increase tool inventories all out of proportion to what they should be and would add greatly to tool costs. Many of the workers who operate machines are not first-class mechanics. They are merely machine operators and have not the regard for a good tool that the true mechanic has. If tools are not carefully controlled, and issued only when needed to such men, the men are likely to be careless and wasteful. Tools are broken unnecessarily and many will find their way into the scrap box. If each tool is issued only as required and if any breakage or damage must be accounted for and if due to carelessness, charged against the operator, tool injury and breakage are greatly lessened.

There are certain requirements which are common to all plants and any system to be effective must be so planned as to meet these basic requirements.

1. *All tools should be designed by the tool design section.* A large percentage of the tools used ordinarily can best be purchased from outside suppliers, but there are instances where tools must be designed to meet special needs or where it is of advantage to make the tools within the plant. In the first case, the tool design section sees to it that the tools purchased are suitable for the work they

are to do. In the other cases the tool design section designs the tools and furnishes the tool manufacturing room with a sketch or drawing. The one who designs tools must thoroughly understand tools and their use. He must have an intimate knowledge of the materials from which tools can be made and the advisability of using certain materials under given conditions. He must understand the product and shop processes thoroughly so as to know the characteristics of the material upon which the tool is to be used, the type of machine, the results that should be accomplished through the use of the tool, etc. A difference in the kind of steel used in making a cutting tool or in the shape of the tool may materially speed up the output of an expensive machine. For example, the use of a drill made of high-speed steel in place of a similar drill made of carbon steel. All of this is a part of the specialized knowledge that the tool designer must have if his work is to be effective.

Whether or not a toolroom should be maintained for the manufacture of tools depends upon the tool needs of the particular concern. Standard tools made on a production basis by tool manufacturers are ordinarily of better grade and can be purchased at a lower cost than those tools can be made in the company plant. An exception may be in the case of some special tools for which tool manufacturers charge a higher figure, due to the fact that they are out of the manufacturers' regular line and to the small number of such tools ordered. In such a case it would probably be advisable to make such tools in the company plant, provided the company has in its employ a competent tool maker. When tools are made in the plant, a sketch or drawing should always be provided. If a tool is made by following a sample, errors are likely to creep in. The sample may be worn, thus causing miscalculations in measurements, or the tool maker may make some slight change which he feels would be an improvement. The change may make a better looking tool but it may not be what is needed. A sketch or a drawing giving exact dimensions insures that all tools will be made alike.

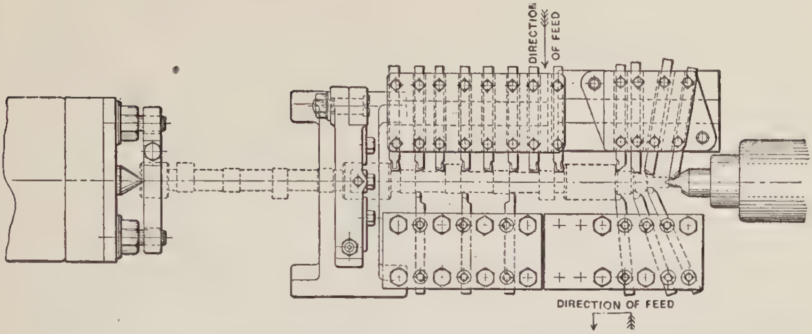
2. *Tools needed for each operation should be specified.* (See discussion of the operation sheet, Chapter XIV.) The tools used determine in many instances the output of the machines in connection with which they are used. The decision as to the proper tools is, therefore, an important one. In mass production work a careful study is made and the proper tools specified. They should be specified by

the engineering division, or tool design section, and tooling instruction added where necessary. This serves to keep the product uniform, to conserve the time of the foremen and operators by deciding for them the tools to use, reduces production cost and increases quality by using the tool best suited for the particular work and, therefore, the one which will turn out more work and of a better grade.

The exception to this rule is in the case of the special order shop or job shop. Making a study of conditions and of available tools and compiling a list of the tools to use in each operation requires considerable time and effort. Unless the same operation is to be repeated again and again it may hardly be worth while, and indeed it would very likely hold up production and prove generally wasteful to go to such effort. In the job shop or special order shop the average worker is of higher grade than is the average worker in the mass production plant. In the latter case, he is a machine operator; in the former a good mechanic. It is advisable, therefore, to leave to his judgment the selection of tools to use. In fact, a first-class mechanic in a special order shop often becomes unusually skilled and ingenious in the use of tools, and turns out quite a variety of products of very good workmanship with a limited number and variety of tools.

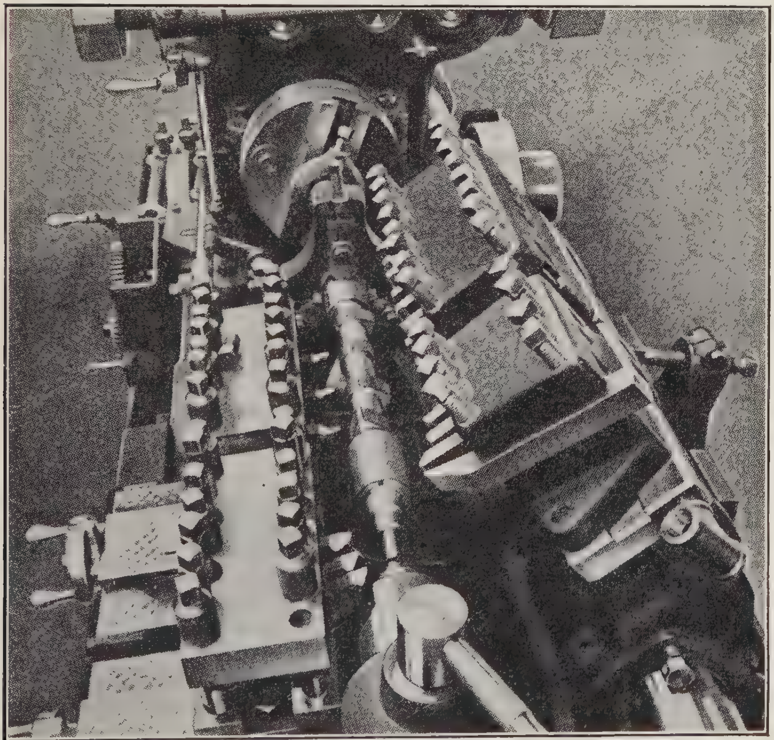
When the tool set-up is complicated enough to warrant it, a tool layout sheet is gotten out for use of the shop. Figure 83-A illustrates a tool set-up as given on a tool layout sheet for a lathe operation on a camshaft. Figure 83-B showing a photograph of the actual set-up of the tools on the lathe, is not supplied to the shop, but is reproduced here to permit the reader better to interpret Figure 83-A.

3. *Tools should be standardized.* In the average shop there are usually found many tools of different makes and of various kinds, sizes and shapes. Economy and speed of production can be facilitated by standardizing tools and so permitting tools to be interchanged, when desired, from one make of machine to another. In standardization of tools, however, as in all industrial work, good judgment and common sense should be brought to play. It may be fine in theory to standardize all tools, but it would not work out so well in practice. There are definite practical limitations. For example, jigs and fixtures cannot be standardized. A jig or a fixture is made for use in connection with a definite operation, and it can be used for one purpose and that one purpose only. Certain standard commercial parts, however, such as machine-screws, washers, taper-pins, cap



(Courtesy of Jones & Lamson Machine Co., Springfield, Vt.)

Figure 83-A. A Tool Set-up



(Courtesy of Jones & Lamson Machine Co.)

Figure 83-B. Photograph of the Lathe Showing the Tool Set-up

screws, etc., can be profitably utilized in designing the jig or fixture. Similarly, table slots by which fixtures are located and held can be standardized, permitting of the use of standard bolts and bolt heads. Thus, the tables of all machines of approximately the same size, whether of a drilling machine, a milling machine or a planer, would have the same size table slot and would call for the same size tongue and T-head bolt to hold the fixture in place.

Among the tools which lend themselves to standardization are included the familiar hand tools, hammers, files, screw-drivers, saws, etc., cutting tools for milling machines, lathes, planers, etc., and certain parts that enter into the making of jigs, fixtures and tool holders. In addition to the advantages covered above, standardization of tools results in a saving in the cost of tools, due to the fewer kinds and sizes purchased, to the fact that tools are active and not lying in the tool crib 90% of the time as many tools do in some shops, and to the working over of worn tools into smaller tools of standard sizes and to the salvage of standard parts in obsolete tools. Standardization of tools requires a close study of the entire tool situation in the plant. Before a standard is set, it must be determined that the tool selected will be the most efficient and economical from an operating standpoint. This study in itself is one of the chief advantages of standardization as it invariably brings to light the use of inefficient tools which are retarding production or detracting from quality of product. A periodic review of the standards set and the keeping of records of tool performance permit of a check upon the efficiency of the standard tools and the change of the standard when a substantial improvement can be made by utilizing another size, shape or kind of tool.

4. *A toolroom or rooms should be maintained.* All tools should be classified and stored so that they are properly cared for and ready for immediate issue when needed. Due to the importance of the subjects of location of the crib, its layout and equipment and tool classification, each will be covered in a subsequent part of the chapter, under a separate heading.

5. *Tools should be inspected and maintained in proper condition.* Workmen should not be permitted to make, repair or sharpen their own tools, as tools made or ground by different workmen for the same operation ordinarily will show decided variations, each grinding to suit his own idea of what he thinks best instead of conforming to

the standard—the one best way. Some workmen are quite proficient in the grinding and care of their tools. Their tools will always be found keen and of proper shape. Other workmen are not so proficient, or possibly they do not want to go to the trouble of properly grinding and caring for their tools. Such men may even run their machines slowly so as to make their tools last as long as possible without regrinding. The effect of such conditions upon quantity and quality of output is at once apparent. A proper system of tool control, by providing inspection and maintenance of tools, removes the possibility of the use of tools which are improperly ground and cared for, eliminates one more source of shop friction, namely, the old controversy between the boss and his men over the question of when a tool is properly ground and what is the proper shape for a tool under a given condition, keeps the machine in operation and conserves the time of the worker by providing duplicate sets of tools, one of which can be ground in the toolroom while he is using the other.

Every tool stored in the tool crib should be in perfect condition, likewise, tools kept in the possession of the workmen or reserved for a special machine should be inspected periodically to insure that they are in good working condition. This necessitates:

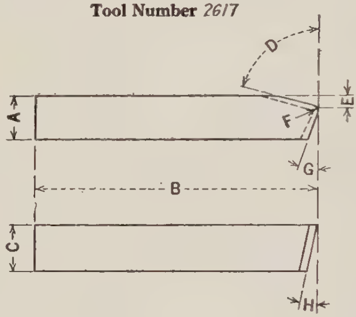
(a) Inspection and check, with specifications, of every tool purchased or manufactured in the plant, before it is placed in the bin or rack.

(b) Inspection of each tool every time it is returned to the crib from the shop. As certain parts of a tool wear out more quickly than others, it is advisable to have simple written instructions as to which parts should receive special attention. For example, an arbor should be inspected for freedom from scratches or flats, wear and condition of centers; a twist-drill for sharpness, condition of point and condition of shank. There are standard inspection codes for the machine shop. These can be used as a guide in formulating the instructions necessary in a particular plant.

All tools that are defective in any manner should be repaired before they are put away in the cribs or racks ready for reissue to the shop. Figure 84 shows the tool angles required for cross slide tool number 2617 on a certain operation in a large foundry and machine shop. As even a very slight variation in the angles of a tool

reduces cutting efficiency, correct angles must be retained at all times. Note that after the part was put into production it was found that a change should be made in angles E and F. After a trial, the changes as marked on the tool card shown were agreed upon. The original measurements for the angles were not obliterated but merely crossed out, so that record is still kept. Note also that maximum length of the tool is 4½ in. and minimum length is 2 in. When this tool has been ground so that it is less than 2 in., it is incapable of being used to good advantage on this particular operation. As noted on the tool

Tool Number *2617*



A	B	C	D	E	F	G	H
3/4"	4½"	3/4"	80°	~~3/32"~~	~~1/16" R~~	10°	5°
				1/8"	3/32" R		

Title	*Cross Slide Tool*
Shank Material	
Bit Material	*#2 Stellite*
Maximum Length	*4½"*
Minimum Length	*2"*
Used on Part No.	*300279*
Used on Oper. No.	*2*
Mach. first used on	*Gisholt*

Maximum Grinds per Day	*10*
Minimum Grinds per Day	*5*
Next Tool No.	*2722*

Figure 84. A Tool Card

card, it is then utilized in making tool number 2722. As indicated, the tool if kept in constant use would require at a maximum 10 grindings per day or under ideal conditions 5 grindings. Ordinarily, the number will lie somewhere between the two. In practice the same tool is not ground that number of times per day, but instead the workman has issued to him a sufficient number of tools to last the day or half a day as the case may be, the used tools being collected by a boy and returned to the toolroom to be reground ready for reissue. When the tools are ground in the toolroom, a tool-grinding machine is used;

when the workman grinds his own tools he grinds by hand, checking his work by angle gages, or more probably judging merely by eye.

(c) Periodic inspection of tool kits in the possession of the workmen or reserved for a special machine or department. All tools in tool kits, or reserved for a special purpose, are in good condition when they are issued. A periodic inspection is necessary after they have been issued to see that they are still in good working order. The instinct to collect things is inherent in all of us. The average workman likes to accumulate a lot of odds and ends. Worn and obsolete tools are very likely to find their way into his tool kit and, unless it is inspected from time to time, he may use them with resultant decreased efficiency, and in some instances risk of danger to himself or one of his fellow workers.

6. *Tools should be delivered promptly to the workers when and where required.* A discussion of the subject of tool distribution will be covered under that heading later on in the chapter.

7. *All tools should be fully accounted for and their exact location known at all times.* This necessitates keeping accurate inventory of tools and their location, and standardization of the method of keeping track of tools under one of the methods described under the heading, "Methods Used in Checking In and Out."

8. *Workmen should be held responsible for all tools used by them.* Records should be kept which will show the exact number and kind of tools issued to each person. Tools should never be issued except upon requisition from an authorized person or upon presentation of a tool check.

9. *Personnel of the tool crib should be carefully selected.* The personnel required for the tool crib varies with the size of the plant and the kind of industry. In a large metal working plant a well-developed organization would probably be needed, including a foreman, one or more tool inspectors, a clerk and a number of crib attendants and laborers or tool boys. Another concern of smaller size or in another industry, may need merely one general crib attendant.

The characteristics of the personnel required to operate a tool system in a large metal-cutting plant will be briefly described, as the tool system is most highly organized in that industry and is therefore the most inclusive.

The tool foreman has general supervision over all work in the tool cribs—the storage and issue of tools, the maintenance of tools

in proper condition, the requisition for replacement of worn tools, the laying out beforehand of the proper tools for each job, and the distribution of those tools how, when and where needed.

The man for the job of tool inspector should be a tool maker, skilled in the use of gages and other measuring instruments. It is his duty to inspect and check against specifications, all tools purchased or made in the toolroom; to inspect all worn or damaged tools and determine their repair or disposition; to inspect periodically all tool kits in the possession of the workmen, or reserved for a special machine or other purpose, and to instruct crib attendants in the matter of inspecting tools returned from the shop to the crib.

The clerk in the tool crib is responsible for the keeping of the necessary records and for relieving the foreman of the toolroom of all possible clerical work, such as the making out of requisitions for replacement ready for the signature of the foreman, the following up of orders and check of receipts against orders, and the making out of orders for repair of tools in the toolroom and the follow-up of these orders.

A man to be qualified for the job of crib attendant should be familiar with tools and their use in connection with the various machine operations. Frequently, it is hard to identify a tool from the description given by the worker who needs it. The crib attendant, due to his knowledge of the tools required for the various operations, can ordinarily give the man the tool he needs after a word or two with him. This requires the use of tact and diplomacy in addition to knowledge of tools and their uses. Among the duties of the crib attendant are:

(a) Issue of tools upon receipt of authorized requisition or in exchange for workmen's tool checks.
(b) Inspection of tools returned from the shop for dullness and damage.
(c) Report of damages to tools noting to whom or what the damage should be charged.
(d) Storage of tools in good condition in their proper places.
(e) Correct marking of all tools, bins and racks.
(f) Filling out of tool list beforehand so that the tools are ready for delivery when needed.

In those concerns which deliver the tools to the worker at his

workplace, tool boys or laborers are needed for delivering the tools and seeing that the worker signs for them. These tool boys also collect the tools after they have been used and return them to the crib, take tools to the toolroom for repair, and do any odd jobs in the toolroom that need to be cared for. By employing alert young men of a responsible type, the company has a source of men who, with a little additional training, can be qualified for the job of crib attendant.

10. *Records should be kept showing performance and tool costs.* All unnecessary paper work should be eliminated in the tool crib. Most tool cribs do not employ a clerk and the crib attendants are usually not of a type who care for clerical work. Certain records, however, are essential to proper tool control. If one shop breaks more of a certain tool during the same period of time than another shop does doing like work, that fact should be known so that conditions can be studied and the cause removed or remedied. It may be that there is some trouble in operation, that the operators are using a greater feed or speed than was recommended by the time study men or by other instructions in the expectation of increasing their output and earnings, or that the percentage of green men is unusually high in that shop or supervision may be at fault. Whatever the trouble is it should be brought to light so that it may be corrected.

In addition to the rate of tool consumption per item, when tools are damaged or unnecessarily worn, records should show the attending causes. Failure of the tool may be due to poor workmanship in making the tool, to a flaw in the steel, to improper hardening or the use of the wrong kind of steel for the purpose. Such facts are invaluable in aiding in the setting of standards and in the choice of the tool manufacturer from whom to purchase tools in the future.

11. *Perpetual inventory should be provided.* A perpetual inventory somewhat similar to the perpetual stock inventory should be maintained for every tool carried. All additions through purchase or by being made in the company toolroom should be entered on it, and all lost, broken or discarded tools subtracted from it. Check of inventory should be made at stated intervals. The number of tools on the inventory should be at all times equal to the number of tools as shown by a physical count, plus the number of workmen's checks representing tools, which they have drawn out and have in their possession, plus the number of repair checks representing tools being repaired.

Location of the Tool Crib.—In a small plant the tool crib is centrally located for the convenience of all. In fact, the toolroom in which the tools are made, ground and repaired, and the tool crib in which tools are stored and from which they are issued, are frequently all in one room. In large plants the toolroom in which tools are made is separated from the tool crib which stores, receives and issues. There is ordinarily a central tool crib serving a number of smaller tool cribs which are distributed throughout the plant, each crib being located where it will be most convenient to the shop or group of machines which it is to serve. Where the amount of grinding warrants it, a small toolroom may be set up alongside of each crib. If the volume of such work does not warrant such maintenance, a central toolroom takes care of all grinding and repair work for all cribs.

Entering into the question of location of the tool crib is the factor of space requirements. This varies with the number, variety and kind of tools handled. Where tools are standardized the variety is less, therefore, space required is less than if tools were not standardized. Space must also be provided for aisles, for making up in advance and holding for delivery sets of tools to meet tool lists requirements, for storage until inspection of all tools returned from the shops, for facilities for issue and return of tools. If the tool crib is cramped for room, the crib attendants cannot give the prompt and efficient service that is required of them. Delay on their part means delay in issuing tools, which may hold up production. This factor should be taken into consideration.

Layout and Equipment Necessary.—In the layout and equipment of a tool crib, provision must be made for the maintenance and adequate storage of all tools. The methods of storage and the equipment used are similar to those described under the heading of storeskeeping. Both wood and steel racks and bins of standard size are used, and both give good service. The metal racks and bins are becoming extensively used, due to the fact that they are more economical in the amount of space required, and that they provide flexibility to care for changes and expansion. Their fire hazard is low, while the fire hazard of wood is high; they are more readily kept clean and they are stronger.

Certain tools, such as the commonly used picks and shovels, do

not fit into the standard bins or racks. In such cases they are kept in racks constructed specially for that purpose, care being used to conform to the floor dimensions of the standard equipment as far as practicable.

For the maintenance of tools, the equipment required would include inspection benches in the tool crib and work benches, tool grinders, grinding and milling machines, lathes, shapers and any other necessary machines for repair work in the adjacent tool repair room.

Figure 85 illustrates a layout of a toolroom. Racks are arranged in sets, back to back, with aisles permitting free access to all bins.

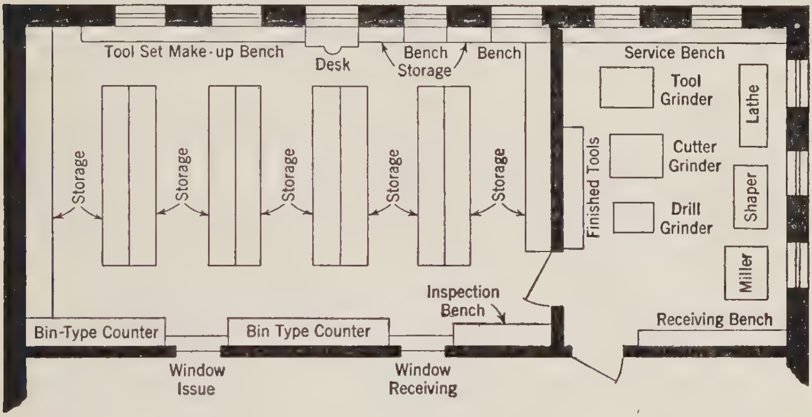


Figure 85. Layout of a Toolroom

Note the inspection bench for inspection of tools before placing them in storage, the benches for making up in advance and holding for delivery sets of tools to meet tool list requirements, also the bin type counters for storage of tools in frequent demand (also see Figure 48).

Classification and Storage of Tools.—Tools should be classified according to the purpose for which they are used, their type and size, each class of tool being given a symbol to distinguish it from all other classes. Each new tool has the symbol of its class stamped into it with a die, the symbol being placed on the shank of the tool in a size and form easily read in the ordinary light of the shop. If the characters are small, time will be wasted in carrying the tool to a light. For tools with round shanks, it is good practice to grind a flat surface upon the shank and stamp the symbol upon this surface.

The tool crib is arranged according to the system of tool classification, all tools of a given class being grouped together in logical order. The markings on the bins should be exact duplicates of the markings on the tools. At a glance, the crib attendant can check a tool with the markings on the bin tag of the bin into which he is putting it or withdrawing it, thus preventing errors in storage and issue.

There are two systems of symbols used in tool classification, namely, numerical and mnemonic. In the numerical system the straight numbering method or the Dewey Decimal method may be followed. Under the straight line numbering method tools are numbered consecutively, the tool number being placed on the drawing when the tool is designed. Numbers are assigned arbitrarily. There is no significance in the fact that two symbols are adjacent. 7654 may be a taper-shank twist-drill, 7655 may be an adjustable blade hand-reamer. The symbol identifies the tool, but it does not aid in storing or withdrawing a tool, the index having to be referred to in both cases. If a change is made in the design of the tool, the tool is given a new number, necessitating a change in the number shown on the drawing and in the index file.

Dewey Decimal System.—In the Dewey Decimal System of classification as applied to tools, a certain key number, 1 to 9, indicates a given class of tools as for example:

1. Cutting tools.
2. Measuring tools.
3. Fixtures, jigs and templates, etc.

Subdivisions of each group are indicated by digits added to the key number as for example:

1.1 Drills
1.1 1 Twist-drills
1.1 1 1 Special twist-drills, two-lipped, and so on.

The classification can be carried as far as it is desired by adding digits to indicate each variable.

The Dewey Decimal method of classification of tools, like the straight number method, requires an index, as the symbol is not descriptive of the tool. Another difficulty lies in the fact that for any given division only ten variables can be provided. With the many

classes and types of tools, it is readily seen that ten variables are not sufficient.

Mnemonic System.—The mnemonic system is based upon the use of letters with the aid of numbers. The letters are suggestive of the class and type of tool, and the figures of the size. The initial letter of the symbol represents the general class. If possible this letter is the initial letter of the name of the class as, for example, G is for gages, D is the initial letter of any symbol representing any tool in the general class of boring, drilling, reaming and tapping tools, and so on. In cases where the name of more than one class of tools begins with the same letter, a letter suggestive of the name is used. The second letter in the symbol represents a subdivision of the class, and if possible is suggestive of the name of the subclass. The third letter of the symbol represents a further breakdown, and so on down to the symbol for the individual tool. In each case, a suggestive letter is used if possible. No index is required, as the mnemonic system is self-indexing. The average tool crib attendant likes the system and quickly becomes familiar with it, so that he can readily withdraw tools from stock or put them in storage unaided. A complete symbol book is always kept in a convenient place in the tool crib, however, so as to be available if needed.

As the late Frank B. Gilbreth expressed it, under the mnemonic system of classification, "All tools that are alike shall be together, and those that differ by one variable only shall be contiguous." For example:

Class D—Drilling and boring tools, etc.
Subclass D D—Drills
Subclass D D T—Twist-drills
Subclass D D T T—Taper-shank twist-drills (standard length)
Subclass ¾ D D T T —¾ inch taper-shank twist-drills

Advantages of Mnemonic System.—Briefly the advantages of the mnemonic system of tool classification may be summed up as:

1. Each tool is identified by a distinct symbol which is stamped into it.

2. The system is simple and easily understood.

3. Flexibility and elasticity are provided. Any number of new symbols for new types of tool can be added to the classification sys-

tem without disturbing the symbols of old tools, and the new tools fit into their logical place in the system.

4. Storage and withdrawal of tools is facilitated. Hunting of tools or looking them up in an index is eliminated. The crib attendant, after a little experience, knows just where to lay his hand on a given tool. A division of the storeroom is given over to tools of a class, thus all tools of a general class are grouped together. Certain shelves in that division are reserved for a given subclass, separate bins, trays, dolly boxes or tote-pans are reserved for further subclasses, the arrangement of tools within a class or subclass being in alphabetical order.

5. Workmen can easily remember the symbols of the tools with which they work. As someone expressed it, the symbols become "shop slang" and add a certain desirable degree of professionalism to the older workers' conversation in the presence of apprentices. The apprentices themselves are keenly alive to symbols and soon learn the significance of the letters, whereas they seldom take any interest in learning the meaning of a numerical symbol.

6. Symbols prevent errors due to different interpretation of the same words by different persons. Mnemonic classification is a "universal shop language." Each person knows exactly what the other person is referring to.

7. Saves time, space and effort in record making. ¾ D D T T can be written more readily, in considerably less space and in less time than ¾ inch taper-shank, twist-drill.

Tool Distribution.—Tool distribution is accomplished in one of three ways:

1. The workmen come to the tool crib for whatever tools they need. This is the method most commonly used.

2. Tools required are sent to the workmen at their place of work. With predetermined tool lists, the list can be filed and the tools delivered to the workmen by a boy or laborer from the toolroom, thus saving time and effort on the part of the workmen and keeping the machines busy.

3. Workmen keep in their possession certain standard tools. This is only done in those instances where the everyday use of standard tools, such as hammers, files, screw-drivers, etc., warrants a set being issued to the workman for his use while he remains in the

employ of the company. The practice of giving a workman the tools he needs and allowing him to keep them in his possession is not general, nor is it to be recommended except in certain cases. Such a practice, if general, would greatly increase inventories and would oftentimes result in the workmen using worn or defective tools or the wrong type of tool. When the workmen get their tools each day from the tool crib and return them to the tool crib at the close of the day, tools can be inspected daily and properly cared for. Similarly if the job calls for the use of a certain tool, if the workman is in the habit of going to the tool crib for his tools, he will go and get the proper tool; if, however, he has some tools always in his possession, he is likely to depend upon these tools and to "make them do," even though another tool is specified and would do the work better.

In the average plant it is not at all uncommon to have all three methods of tool distribution used in different parts of the same plant, each being used where it will best serve tool needs.

Methods Used in Checking In and Out.—In all cases of tool issue, record should be kept and the worker charged with the tools he receives. When a kit of standard tools is given to the worker to be kept in his possession, the tools are listed on a standard form which the worker signs as a receipt. When tools are delivered to a worker at his machine or he goes to the tool crib for the tools he needs, one of several methods may be used, the single check method, the double check or the written requisition.

Single Check System.—A workman upon being employed is provided with a definite number of tool checks, each bearing the man's employment payroll number. The number of checks given to a particular workman depends upon the class of work he is employed to do. When a tool is issued to a workman, he gives a check in exchange for each tool, the check being placed on a hook in the bin or rack from which the tool is taken. When a tool is turned in, the workman's check is returned to him. The workman is held responsible for all checks issued to him, and their use. Upon discharge or voluntary leaving the employ of the company, the workman is required to return the number of checks given to him. If any are missing he is charged a fixed sum for each missing check (usually 25c or 50c).

The disadvantages of the single check system are:

1. It does not show the number or kind of tools a workman has out without checking over the entire crib.

2. A dishonest workman can easily take advantage of the weak points in the system. He may draw out a valuable tool which he desires for his personal use or which he wishes to give to a friend or to sell. When it is found that he is short one of his checks he says he lost it. He pays the sum which is charged when a tool check is lost. This ordinarily is only 25 or 50 cents, while the tool is probably worth many times that sum. While the very great majority of workmen are absolutely honest in every respect, there is an occasional workman who is not as honest as he should be. The tool system should be so devised that such men are not given the opportunity to be dishonest.

3. Checks are occasionally placed on the wrong hook or they get knocked off the hooks on which they have been placed. A workman returns a tool and asks for his check. It cannot be found. As he is returning a tool it is his right to demand his tool check. If there are a great number of checks on the hooks in the tool crib, it is impossible to go over them all to see if the check can be found.

The single check method can only be used satisfactorily in cases where the number of workers and the number of tools issued are both small, thus permitting of easily examining all checks if necessity arises, or in cases where the tools are few and of such size or character that the workers will have no desire or opportunity to take them for personal use. Even in such instances, however, the double check system or the written requisition system may prove more desirable.

Double Check System.—Each workman upon being employed is given a stated number of checks bearing his number, as under the single check system. When a workman draws out a tool his check is put on a hook in the compartment from which the tool was taken and at the same time a check bearing the symbol of the tool is put on a hook bearing the workman's number on a tool control rack located convenient to the tool issue window. When the workman turns in the tool, his check is returned to him and the tool symbol check is taken off his hook on the control board. It is known at all times the number and kind of tools held by each workman and the exact location of each tool. The double check system is the system most used.

Under both the single check and the double check system, issuance of tools can be facilitated by the use of denominational checks. These are checks of a distinctive shape which are marked on the back with numbers. Thus, if a workman needed six identical turning tools for the same lathe operation, instead of giving six single checks he gives a single check with six marked on the back, or two checks of the three denomination.

Another check required is a repair check. It, likewise, should be of distinctive shape and plainly marked with the word, repair, or the letter R. When a tool is withdrawn for repair the repair check is used similarly to the way a workman's check is used.

Written Requisition.—When a written requisition is used, in order to obtain the extent of control possible under the double check system, the workman makes out his requisition in triplicate; that is, the original and two carbon copies. Each copy should be of a distinctly different color. The original is filed in a cabinet under the number of the workman, a copy is filed in a tool file under the symbol of the tool, and the third copy is given to the workman. The workman returns his copy at the time of turning in the tool and receives the copy filed under his name, which he destroys. When the tool is returned to its place in the crib, the copy in the tool file is taken out and destroyed.

Advantages of Tool Control.—Tool control, like material control, aids in raising the standard of the plant and the quality of the product, and at the same time cuts down the cost of production.

The following are among the specific advantages:

1. Reduces capital tied up in inventory. A minimum of tool stock consistent with the production requirements can be carried.

2. Aids in maintaining the quality of the product. Good tools permit of good workmanship.

3. Lowers the cost of production. With proper tools, work can be turned out in less time and with less spoilage and scrap.

4. Lowers the cost of labor and machine time by eliminating costly delays due to lack of suitable available tools, and by prompt and efficient service in issuing tools.

5. Reduces the cost of tools. Proper care prolongs the life of the tool. Worn tools are salvaged. Losses due to theft and wasteful usage are prevented.

CHAPTER XXIV

PRODUCTION CONTROL

Process of Production.—Production has been defined as the process of assembling parts or transforming materials in such a manner as to increase their usefulness. Manufacturing concerns may be classified, broadly, into (1) assembly industries in which individual parts are made or purchased and finally are assembled into a finished product as in the automobile industry; and (2) continuous industries in which raw material moves from one operation to the next, each successive operation adding to the work of the previous one, until the material comes as a finished product as in the paper manufacturing industry. Both assembly industries and continuous industries may be further subdivided into those manufacturing a single standard product and those making a variety of products. The latter class may be still further broken down into those producing (1) standard products, (2) to customers' orders, and (3) both standard products and to special orders.

It is obvious that the manufacturing methods and details of operation are necessarily different in each of these. However, in any case it is necessary to plan in advance. But planning is of little value unless there is subsequent control to make certain that these plans are followed. It must be borne in mind, however, that production rarely goes smoothly for any length of time without an emergency arising. For that reason, the control method used in any case must be so designed that it will be flexible and provide for taking care of breakdowns and all other conceivable daily happenings in the shop, otherwise plans will be disrupted at the first emergency. It follows, then, that production control methods must be developed to fit the needs and conditions found in each individual plant. No cut and dried method can be developed for any one group or class of industry nor even for any two concerns.

Occasionally you will find an executive who will say, "Production planning and control is all right for those that can use it, but our business is different and it can't be done in our plant." He is prob-

ably right in saying that his business is different. But he is not right in that he says that production planning and control cannot be profitably utilized in his plant. The truth is that he is of the old school, the old-fashioned type who rely solely on their own past experience and guesswork. Even in plants manufacturing to customers' specifications, some planning is not only desirable but necessary if production is to move smoothly and economically.

Planning and Control.—The Dayton Steel Foundry Company,[1] manufacturing steel wheels to customers' specification with the variety of designs required to meet these specifications necessitating three thousand wheel patterns, plans and controls work in process from the production department. Similarly with other concerns, both of the assembly and continuous or progressive type. The Belden Manufacturing Company,[2] manufacturing insulated wire, cable, cordage and coils with most of the manufacturing processes of the progressive type, plans and controls work in process, with the object of prompt fulfillment of production schedules with the minimum process inventory. Part of their production is standard products and part is to special customer requirements.

Although the work in some shops cannot be planned so far in advance as in others, experience has shown that it is possible to plan ahead and then, when an emergency or the unexpected occurs, change the plans accordingly. Even in shops making a great variety of products and in jobbing shops, experience shows that more than 75% of what has been planned comes through as predetermined, hence only a comparatively small percentage of things has to be handled by emergency means. The same accuracy cannot be expected in such shops as is attained in repetitive manufacturing, but waiting time between operations can be materially reduced and jobs can be completed in less time and at a lower cost. In an assembly industry, if any of the parts entering into the finished product do not reach the assembly room on time, production will be held up. It is safe to say that at times every manufacturing concern has experienced more or less of this difficulty. The usual result is that shipment of the entire product has had to be held up, the assembly floor is clogged

[1] J. D. Towne, Planning and Controlling Work in Process in The Dayton Steel Foundry Company. American Management Association, Production Executives' Series No. 62.
[2] C. S. Craigmile, Planning and Controlling Work in Process in the Belden Manufacturing Company. American Management Association, Production Executives' Series No. 54.

with partly assembled products, money is tied up in materials that should have been shipped, production on other work is slowed up, and the workers on the assembly line stand idle, with the usual resultant increased costs and most likely an irate and disappointed customer due to the delay in shipment.

Such delay or trouble may be due to an accident, breakdown of the machinery, men quitting without notice and other unavoidable causes, but in the vast majority of cases it is due to the fact that parts have not been put into production in time, the operation on these parts not properly scheduled or the schedule not carried out so as to provide sufficient quantity of correct parts arriving at the assembly room at the time when needed.

Every industrial concern endeavors, more or less, to control its production activities. In this present discussion we are assuming that the concern is properly functionalized, and that the operating division (the line division which actually does the work on the machines and is responsible for both quality and quantity) is distinct and separate from the production engineering division,[3] a staff division which in the highly centralized type may make all arrangements as to the order in which work will be run, the scheduling of work, the machines, tools, workplaces, materials and employees to do the work, and everything pertaining to the facilitation of performance of scheduled work.

Kinds of Production Control Methods.—Broadly speaking, there are three kinds of production control methods, the centralized, decentralized and what might be spoken of as partly centralized. The latter is merely a combination of the two basic types. In practice there is no one such type, but rather each concern combines the centralized method with the decentralized method in such a way as to have the resultant method best fit the needs of the particular case in question.

Centralized Method.—With this method the centralized planning section receives from the engineering department details regarding the manufacturing orders such as the work to be done, where it is to be done, what machines or equipment are to be used and the materials required. The planning section then plans the exact sequence of production of parts so that all parts entering into an assembly will be

[3] Frequently called the production division.

brought together on the assembly floor at the same time. It reserves on the stock records the amount of materials or parts required, and if need be places a purchase requisition with the purchasing agent. It makes all arrangements for the factory in regard to materials, tools and equipment and sometimes even assigns work to particular machines or workmen. Furthermore, the planning section issues tickets which release and control work in the shop. It then closely follows up production during each day so as to compare actual results with the preplanned schedule, so that if production lags anywhere along the line, corrective steps may be taken at once.

Decentralized Method.—This method is directly opposite to the centralized type. With the decentralized method each foreman is given a copy of the orders to be manufactured in his shop. He is responsible for seeing that the necessary supplies, materials and tools are available and that work is laid out to the machines on which the work should be done. He is responsible for so planning the work ahead of each machine that idle time is cut down to a minimum and the work is put through the operations to be performed as quickly and as economically as possible. It is evident that with the decentralized method no separate planning division is necessary. When the shop is large, employing a hundred or two hundred or more men as many of them do, the foreman would have to have assistance in the planning and control of his shop. If the need is great enough the shop might maintain a planning section of its own, the number of persons in the section depending upon the amount and kind of work covered.

Partly Centralized Method.—Between the centralized and decentralized methods it is possible to set up any number of methods which may vary all the way from one extreme to the other, each designed so as to best fit the conditions in the particular plant in question. It is not at all uncommon to find in practice a method which is about midway between the strictly centralized and the strictly decentralized methods. Under such a method there would be a centralized planning section which would receive and analyze all orders to be manufactured. It would schedule the orders and the work to be done to each manufacturing section or shop. The foremen of the respective shops would, in turn, plan and control the work within

their own shops so that the work required could be gotten out in the time allotted. The central planning section, in addition to scheduling the work to be done by each shop, would receive daily reports, or more often as the case may be, of work done in each manufacturing section to see if actual production were keeping up with that which was scheduled and if not, suitable corrective steps would be taken. Such a method provides central control and at the same time permits of greater flexibility within a shop to care for everyday happenings to which a schedule under the centralized method might not be so readily adjusted.

Method to Use and Extent of Planning.—The production control method to use in a particular plant cannot be chosen arbitrarily. It depends upon numerous things, some of which have already been mentioned. At the beginning of this chapter a broad classification was made of kinds of manufacturing concerns. The method of planning and control varies considerably with the class of manufacturing. The planning required after the initial planning in continuous industries manufacturing a standard product is practically negligible, but in concerns manufacturing a variety of products it would be quite complicated. Planning, for example, in a cement plant is very different from that in a factory manufacturing radio sets, or clothing or in a jobbing shop.

Similarly, the method of planning and control is influenced by whether manufacture is to stock or for each order only, or whether certain parts are made to stock, thus facilitating the manufacture and assembly of completed products on special order.

The way in which the plant is organized and the extent of development of management methods also would have a marked influence. For example, time study and job standardization, which are management methods, are not absolutely necessary for planning, but without them it is necessary to make large allowances with resultant inaccuracy and looser control. Other management methods such as the extent to which budgeting has been developed, the method of keeping stock records, the method of "tying-in" production records with payroll and accounting methods, etc., all have a bearing on the organization of the planning section and methods of control.

As was said before, there is no one best method of planning and control; each has its advantages under given conditions. The method

to use in a particular plant is the simplest method that can be devised that will meet the needs and provide for an even flow of production. Hard and fast rules can rarely be adhered to in any industrial concern. A system to be effective must be flexible so that it can be readily adjusted to meet changed conditions. Red tape defeats many a system which looks well on paper. Details must be planned for and controlled, as it is the effective control and coordination of details that make production move smoothly, but in planning and controlling details, care must be exercised or so much attention will be given to details that the real object of planning will be lost sight of.

In the discussion that follows, the methods used in a large assembly plant manufacturing the same general line of products, part standard products and part to customers' specifications, will be described, as methods under such conditions must necessarily be more involved than in the industrial plant manufacturing a single standard product. The methods presented are not advocated for general use, but merely as an example of a system which has worked out well in practice. Following the discussion will be given an application of production control methods in a large automobile company and in a jobbing shop. These can be used as a guide in devising a system for a particular plant, always bearing in mind, however, that the details and even the general scheme of operation would very probably have to be modified in order to have the system devised cope satisfactorily with the particular conditions, and yet have the system the simplest system that will be efficient for control purposes and flexible enough to meet fluctuating conditions.

Elements Entering into Production Control.—Before considering the method by which production control operates, it may be desirable first to consider the elements of which it is composed. These elements are:

1. *Demand.* A knowledge of what to make, the quantity of each kind and size of product to make and the time in which to make it to meet variations in demand. Uniform rate of demand is an ideal condition, but it is rarely, if ever, found in industry. Meeting variations in demand with a minimum of changes and confusion in the shops is one of the prime objects of planning for production.

2. *Product analysis.* An analysis of the products so as to de-

termine their component parts and the materials required for the manufacture of them.

3. *Material control.* Complete up-to-the-minute knowledge of the amount of material on hand in the storeroom, the amount on order but not delivered, the amount appropriated or reserved for definite manufacturing orders, and the amount available for future manufacturing orders. It also includes the routine from purchase requisition to the delivery of the finished product to the storeroom or shipping section. This includes the requisitioning for purchase and the purchasing of materials in accordance with a predetermined manufacturing schedule, their receipt and inspection as to meeting predetermined specifications, their receipt and proper care in stores, their issue to the operating division or manufacturing sections upon properly authorized written requisition and the movement through the shop until they are delivered as a finished product to the shipping section or storeroom.

4. *Routing.* The determination and the assignment of sequence of operations, of the standard time required for each operation and of the place at which each operation should be performed. The shortest, most practical and economical path from raw stock to finished stores.

5. *Scheduling.* "Scheduling is the determination of the relative time at which each operation or event in connection with manufacturing will occur." (This will cover the determination of all times involved from the time required to secure the necessary raw materials to the time required for final assembly.) [4]

6. *Dispatching.* Dispatching is the releasing of work and the directing of its movements in accordance with the route and schedule laid down for it. (The mechanism of dispatching and scheduling must be such as to provide flexibility of operation to meet all emergencies and irregularities.)

7. *Time study.* Basic and underlying all economical manufacturing is time study work which in its broad meaning includes job standardization. Two of the major functions of time study are, first, to determine the one best way of doing a task and second, to determine the proper elapsed time for doing the task in the one best way. These in turn, among other things, serve as a basis for better

[4] Definition by G. D. Babcock, Management's Handbook, p. 637.

control of routing, scheduling and dispatching, and for establishing an equitable wage and incentive for the workers.

It is understood, of course, that adequate inspection is provided by the inspection division as discussed in Chapter XXII. Though the forms in production control mechanism are used primarily to facilitate production, these same forms also are used secondarily for timekeeping and payroll purposes and for costing. Each of these seven elements will be discussed, thus giving as comprehensive a description of production control as is possible in the space allotted.

Demand.—Sales demand governs production. To produce goods far in advance and hold them in store while demand is created, greatly increases costs and lessens the chance of ultimate profit. Planning for production requires as accurate an estimate of the sales requirements as is possible, and this is secured by means of the sales budget. It is evident, then that the degree of success of production planning and the economies to be derived from such planning in a given plant depend to a large extent upon the accuracy of the sales budget. As to the methods of determining the sales budget this is covered in the discussion of budgetary control, Chapter XXXII. The budget must be expressed not only in dollars and cents, but also in terms of physical units of each of the various types and sizes of products or items that are to be manufactured, otherwise it would be impossible to secure effective coordination of sales, production and purchasing. It is evident, then, that the sales budget acts as a production guide for an intelligent program of manufacture which will insure a supply of merchandise in advance while keeping inventories in proportion to demand. It also permits setting up an intelligent program of purchasing, makes it possible to a great extent to smooth out the peaks and valleys in production, and tends to minimize costly fluctuations of employment which decrease efficiency and contentment of labor.

After the sales estimate for each product or item has been determined for the budgeted period, it should be properly prorated or broken down to monthly estimates, thereby making it possible to detect seasonal and other fluctuations. The detrimental effect of seasonal production is far reaching and seriously affects the profits of a concern. Too strong emphasis cannot be placed on the importance of overcoming or offsetting seasonal fluctuations as far as possible.

Manufacturing Program.—In a concern where the demand for its products is fairly constant throughout the year, it is not difficult to set up a fairly uniform manufacturing program. Where the demand is seasonal or fluctuates it is desirable, in so far as possible to equalize production throughout the year in such a way as always to meet the sales demand, yet at all times keep the inventories at a minimum consistent with the demand. Often it is not possible to concentrate on the production of one item or product in large quantities and then concentrate on another, but in order to keep the shop equipment busy and to keep down labor turnover, it may be necessary to keep a quantity of certain items in production at all times. It may be that too great a variety of products would place such demands on production that it would be impossible to make a profit. The procedure in such a case is to make a careful analysis of market demands, competition and your own manufacturing facilities, to determine which articles you can produce and distribute to best advantage and then concentrate on them. In other words, practice simplification, standardization and elimination of excess variety as discussed in the chapters on the engineering department and on waste and its elimination (Chapters XIV and XXXIII).

Another point to bear in mind in developing manufacturing schedules is to keep them in accord with machine capacity. The schedule must be so arranged as to make maximum use of machines and not have them overloaded at certain times and idle at other times. Over a budgeted period there may be sufficient total machine capacity, but an unfortunate production program may require the service of certain machines to work on several parts or products at the same time, which, of course, is impossible, and causes much delay and confusion. To reiterate then, the general manufacturing program should be arranged in accordance with machine capacity over the budgeted period and with the general capacity of the factory in terms of the several products manufactured.

In some plants, due to diversity of products, the demand may be of such character that analysis and scheduling of work as above suggested would be impractical. In such a case it may be best to treat each order separately, scheduling them by machine capacity in the order in which the orders are received or according to delivery date requested.

Determining Kind and Quantity of Material Required.—The engineering department [5] not only gets out the blueprints and specifications, but also draws up a parts list and operation sheets for each product or article manufactured. These, after the sales demand has been determined, are the basis for all planning and control work in the manufacture of the articles. The parts list and the operation sheets are used by the cost division as a basis for determining standard costs, by the production division for routing and scheduling purposes, for the reservation of raw material and parts to cover the manufacturing order or the requisitioning for purchase of such material and parts if sufficient quantity is not available, etc., and by the tool design section for the scheduling of the manufacture of new tools, jigs, fixtures, gages, etc., necessary for use in the manufacture of the product.

To determine the amount of the various kinds and sizes of raw materials and "purchased parts" required to manufacture a given product, simply resolve or translate the parts list covering that product into raw materials and "purchased parts." It is then a simple matter to determine the total required amount of raw materials and "purchased parts" necessary to manufacture any definite quantity of an article or to fill any manufacturing order for that article. By doing similarly for all articles or products manufactured, the total aggregate requirements of each kind of raw material and "purchased parts" covering the factory's total output for a given period can be determined.

Frequently the same part is used in more than one place on the same article or product, and also may be used in two or more products. This must be taken into consideration when determining the "quantity to be manufactured" of any such parts. This secures economies in manufacture as it permits of larger runs.

Material Control.—The third element in a production control system is adequate material control. This subject was covered in Chapter XVI, Storeskeeping. Therefore, here mention will only be made of the forms needed and a very brief review of the routine in handling them so as to show the connection between material control and production control.

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[5] See Chapter XIV.

1. Purchase requisition
2. Purchase requisition follow-up
3. Receiving, inspection and transportation cost reports
4. Identification tag
5. Defective material tag
6. Bin tag
7. Stock ledger
8. Stores issue slip
9. Stores credit slip
10. Material received from manufacturing order form

Purchase Requisition and Follow-Up Forms.—The purchase requisition (see Figure 40) is made out in triplicate, the original and one copy being sent to the purchasing department and the third copy retained by the materials control section in a tickler file. The original copy is retained by the purchasing department, and the carbon on which the purchasing department makes notation of the purchase order number and the date on which the purchase order was placed, is returned to the material control section for its information. Inasmuch as the material control section is vitally interested in the receipt of the items ordered, it should make sure that delivery is made not later than the date specified, hence they should "follow up" the purchase requisition. The tickler file copy of the purchase requisition will automatically come out on the specified date. If the material has not been received, then a "Material Due on Purchase Requisition" form should be used for communicating with the purchasing department and their reply.

Material Received Notice Form; Inspection Report; Transportation Cost Report; Bin Tag.—The incoming shipment should be checked as to quantity, quality and agreement with any conditions specified on the purchase order. When the items are received, the receiving clerk fills in the required information on the receiving form (see Figure 49) which is made out in triplicate. The material and a copy of the receiving slip are then turned over to the inspection division. The inspection division makes out its report of quantity accepted and rejected and reasons for the rejections, and attaches "defective material" tags (see Figure 50) to the rejected items. The receiving clerk writes out and attaches bin tags (see Figure 51) to the accepted material. The attaching of the bin tags is a signal to the

truckers to take such material to the storeroom as indicated on the bin tag.

A copy of the receiving report is sent to the traffic section where entries are made on it of all transportation charges. This copy is then sent to the stock ledger clerk who has also received the original and the inspection division's copy and report which in the meantime has been sent to him. The stock ledger clerk makes entry on the original and the inspection division's copy of the price as taken from a copy of the purchase order, and the transportation charges as taken from the traffic section's report, thus computing the total cost. From the original the stock ledger clerk makes entries on the stock ledger of the date, the amount and value of material accepted. The carbon copy is sent to the purchasing department for them to close out the transaction.

The purchasing department, upon receiving the copy of the receiving slip with the inspection report and after receiving an estimate from the operating or production division or salvage section as to the cost of repairing or reconditioning the defective material if such can be done, takes whatever steps may be necessary to straighten out the transaction with the vendor and notifies the accounting division so they may charge back the vendor accordingly.

Stores Issue Form.—The material issue slip grants proper authorization for issuance of materials. (See Figure 52.) In addition, it gives information as to the delivery place in the shop for the first operation, supplies unit cost and value for accounting purposes, supplies information to the stock ledger clerk for proper entry on the stock ledger, and may in some material control systems be used in connection with control purposes with certain other duties which are necessary in handling manufacturing orders. Under a system of production control, at the time of issuance and analysis of the manufacturing order material issue slips are made out for the material required in the manufacture of all parts. The material issue slips are then checked against the stock ledger. If the material is available the ledger clerk makes entry on the stock ledger and writes his initials and date in the appropriate space on the issue ticket. If the material must be ordered, he sends through the required purchase requisition and places a copy of it in a tickler file. The follow-up form on the purchasing department is used if delivery is not made

before the slip automatically comes out on the tickler date. On the issue slip is also entered the date the material is due in the shop and the location of the machine or other workplace for the first operation. Spaces are also provided for the entering of the date and initials of the person who issues the material from the stockroom, and the person receiving it.

If several materials or parts are required, as for example in an assembly, a group issue slip is used instead of a single issue slip. The same information given on the single issue slip is incorporated on the group issue slip. (See Figure 53.)

Identification Tags.—Attached to and accompanying all material or parts which are issued from the storeroom is an identification tag (Figure 102). The tag serves to identify the material, to keep it from being used for other purposes than those for which it was issued, and to prevent the lot from becoming separated while passing through the various sequence of operations during manufacture. Under certain conditions the identification tag may take the form of an identification route ticket. If any defective material is discovered or scrap occurs during manufacture, proper notation is made on the identification tag and a defective material tag is attached to such material or parts which are immediately removed from production channels. (See Figure 50.)

Stores Credit Form.—If after material has been issued from the storeroom it is returned to stores, or if it is secured from other sources than through the regular purchasing channels, or if it is diverted to another order, a materials credit form is issued. (See Figure 54.) This form gives information as to the description of the material, quantity, reason for its return and to what order it should be credited. On the credit slip should also be written the symbol number of the material or parts and information as to its location in the storeroom, its unit cost and value, and so on. A copy of the material credit slip should be sent to the stock ledger clerk for making proper entry on the stock ledger, while another copy is sent to the cost division for accounting purposes.

Material Received from Manufacturing Orders.—When materials from a manufacturing order are placed in finished stores, a material received from manufacturing orders form is used

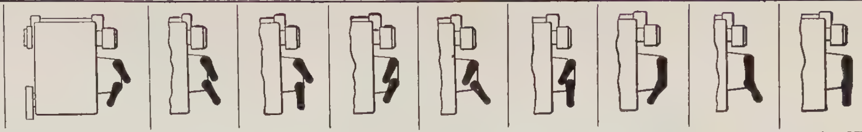
(Figure 55). On this form are given the stores symbol, the order number, the quantity required on the order, the quantity received at that time, the total quantity received to date and a statement as to whether the order is now complete or not. Space is also provided for stating from whom or from what operating center the materials are received so that credit can be given.

CHAPTER XXV

ROUTING

Routing Defined.—The third element in production control is routing. As stated in the last chapter, routing is the determination and the assignment of sequence of operations, of the standard time required for each operation and of the place at which each operation should be performed. Routing determines the shortest, most practical and economical path from raw stock to finished stores. It is self-evident that after the proper plant layout has been made routing in a continuous industry is a simple matter. In order to permit of an adequate discussion of the problem, routing in an assembly industry will be taken up. In an assembled product this would include not only the operations required in the manufacture of each component part, but also in making each assembly, that is each sub-assembly or minor and major assembly, as well as the final assembly. With the definition of routing as a basis, it is evident that several factors enter into routing, each of which will be briefly discussed.

Determination of Best Method to Use—Available Equipment.—In determining what operations are necessary in order to manufacture a finished part, it should be remembered that there are several ways in which the same desired result may be accomplished. In a machine shop, if it is desired to make a flat surface on a part, such may be obtained by doing the operation on a planer or on a milling machine, or on a wet surface grinder or in other ways. Therefore, regardless of what the part is made of or whether it is made in a foundry, a machine shop, a wood shop or where, it is necessary to study the product and decide which of the several possible ways of doing the job is best, all factors being considered. In making the decision, the relative amount of time required by the several methods is not the only factor to bear in mind. It may be that by one method the probabilities of getting the least amount of defective work or scrap are better than by another method. Another factor is what or how much equipment is available for the several methods

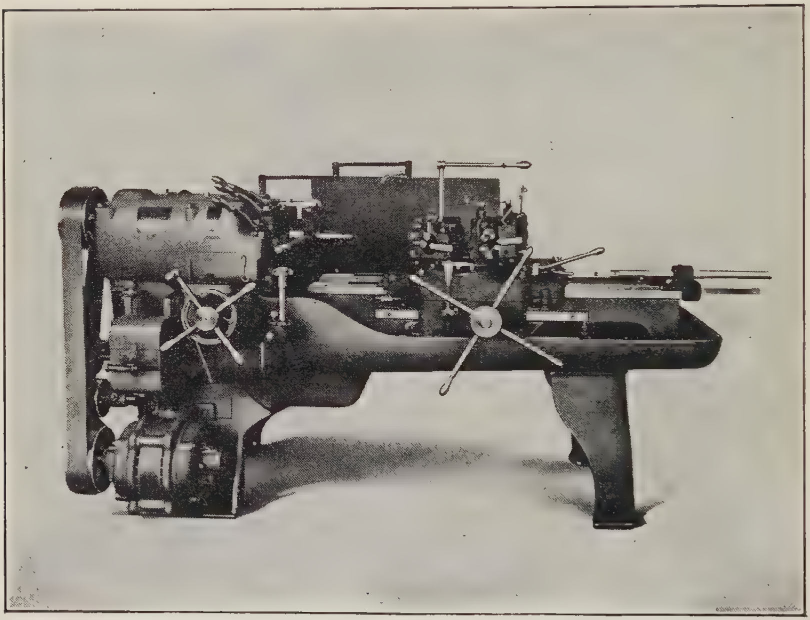
Diagrams Showing Clutch Lever Positions (Speed of Driving Pulley 800 Revolutions per Minute)											Feet per Minute
Spindle Speeds—(Approximate Revolutions per Minute)		284	180	118	88	55	36	32	20	13	
Screw Thread Cutting			5/16	5/16 1/2	7/16 5/8	11/16 1 1/16	1 1/16 1 5/8	1 1/8 1 13/16	1 15/16 2 7/8	2 15/16 4 3/8	10 15
Turning Speeds for Carbon Steel		1/4 5/16 3/8 7/16 9/16 5/8	7/16 1/2 5/8 3/4 7/8 15/16	5/8 13/16 1 1 1/4 1 5/16 1 7/16	7/8 1 1/16 1 5/8 1 1/2 1 3/4 1 15/16	1 3/8 1 3/4 2 1/16 2 7/16 2 3/4 3 1/8	2 1/8 2 5/8 3 3/16 3 11/16 4 1/4 4 13/16	2 3/8 3 3 5/8 4 3/16 4 3/4 5 3/8	3 13/16 4 3/4 5 3/4 6 11/16 7 5/8 8 5/8	5 7/8 7 3/8 8 13/16 10 5/16 11 3/4 13 1/4	20 25 30 35 40 45
Turning Speeds for High-speed Steel		11/16 13/16 1 1/16 1 3/8 1 11/16	1 1/16 1 1/4 1 11/16 2 1/8 2 11/16	1 5/8 1 15/16 2 5/8 3 1/4 4 1/16	2 3/16 2 5/8 3 1/2 4 3/8 5 7/16	3 1/2 4 3/16 5 9/16 6 15/16 8 11/16	5 5/16 6 3/8 8 1/2 10 5/8 13 1/4	6 7 3/16 9 9/16 11 15/16 14 15/16	9 9/16 11 7/16 15 1/4	14 11/16 17 5/8	50 60 80 100 125
	Feeds per Inch	Time Required to Travel One Inch									
Turning Feeds (For Gear Feed Machine)	20 30 40 50 60 75 90	.07 .11 .14 .17 .21 .26 .31	.11 .17 .22 .27 .33 .40 .50	.17 .25 .34 .42 .51 .63 .76	.23 .34 .45 .52 .68 .85 1.0	.36 .55 .73 .88 1.1 1.4 1.6	.56 .83 1.1 1.4 1.7 2.0 2.5	.63 .94 1.2 1.6 1.9 2.3 2.8	1.0 1.5 2.0 2.5 3.0 3.7 4.5	1.5 2.3 3.0 3.8 4.6 5.7 6.9	
Drilling Feeds	100 120	.35 .42	.56 .67	.85 1.0	1.1 1.3	1.8 2.2	2.8 3.3	3.1 3.7	5.0 6.0	7.7 9.2	

(Courtesy of Jones & Lamson Machine Co.)

Figure 86. Table of Speeds for 3 x 36-Inch Flat Turret Lathes

open. It may be that certain operations can best be done on a milling machine. A sufficient number of milling machines are not available. Instead of holding up production by delaying certain of the operations until the necessary milling machines are available, it would be better to study each operation and see if other available equipment would not serve the purpose. A study may show that a planer is available and could be used on a few of the jobs.

In making a study it should be noted what, if any, special equipment would be needed when employing each of the several probable methods. Not infrequently it is found that a relatively difficult operation can be made comparatively simple and easy through the use of well-designed special tools or auxiliary equipment.



(Courtesy of Jones & Lamson Machine Co.)

Figure 87. 3 x 36-Inch Flat Turret Lathe with Cross Sliding Head (Motor Drive)

Machine and Equipment Inventory and Capacity.—"The capacity for production is a matter of machine equipment, and hence, since planning is essentially the manipulation of this capacity to meet demand, a detailed knowledge of equipment is the basic necessity for

its operation."[1] This necessitates an inventory of all available machinery and equipment, and definite knowledge of the capacity of each. Such an inventory is also used by the maintenance division for various purposes and by the accounting division for appraisal purposes, should it be desired.

Machine capacity depends upon several things—upon the type and kind of machine, the particular kind of work being done, the materials worked and the method of operation. The average person does not differentiate between various machines in a given class. To him a lathe is simply a lathe. The worker in a shop, however, knows that all lathes even of the same size do not have the same capacity for turning out volume of work. Similarly, he knows that the capacity of a machine will vary with different kinds of work and with the materials worked upon. Cold rolled steel can be readily machined, while with chrome nickel steel forgings a much lower feed and speed must be used and, therefore, a smaller quantity can be turned out in a given time. The various combinations of speed and feed which may be gotten on a machine are made known by means of a table which gives this specific information. Such a table may be supplied by the manufacturer of the machine in question or possibly it may be necessary in some instances for the tool and equipment section to compile them. Figure 86 is an illustration of such a table covering the machine shown in Figure 87.

The proper speed to use in cutting various materials varies widely. However, tables of cutting speeds have been compiled which serve as a guide. Figure 88 is an illustration of such a table. The best feed to use corresponding to a given speed and depth of cut and to the nature of the work is also obtained from a table compiled for that purpose. It is impossible to give fixed cutting speeds and feeds for all work, as so much depends on the material, and the accuracy and finish desired. Therefore, the figures given are merely guides.

The object of a machine analysis is to know the capacity under all the varying conditions which may exist or be met with in the shop.

How to Find Cutting Time.—The following is an illustration of how these data are used in practice. In turning down a steel forging to a specified diameter, the surface cutting speed in feet per minute, or "cutting speed," as it is usually referred to, is determined

[1] G. S. Armstrong, Planning and Time Studies, Industrial Extension Institute, New York.

by multiplying the circumference of the work in feet by the revolutions per minute of the work or expressing in terms of a formula and transforming the equation:

$$\text{R.P.M. (required to secure a desired cutting speed)} = \frac{\text{Cutting speed (feet per min.)}}{0.26 \times \text{Diam. (in inches)}}$$

The desired cutting speed for the particular material in question is obtained from a table (see Figure 88). Hence, knowing the dia-

Material	Turret Lathe Practice Surface Feet per Min.
Soft Cast Iron Roughing	50 to 60
Soft Cast Iron Finishing	60 to 80
Hard Cast Iron Roughing	35 to 50
Hard Cast Iron Finishing	60 to 80
Malleable Cast Iron	80 to 90
Steel Castings	50 to 60
Brass	150 to 250
Bronze	100 to 150
Hard Bronze	80 to 100
Copper	150 to 200
Aluminum	250 to 400
Soft Machine Steel	80 to 100
Medium Hard Machine Steel	60 to 80
Hard Machine Steel	40 to 60
Tool Steel—Annealed	60 to 80
Tool Steel—Unannealed	25 to 35
Alloy Steel Annealed	50 to 60
Alloy Steel Treated	30 to 40
Cutting Threads on Brass	60 to 150
Cutting Threads on Steel or Cast Iron	25 to 40
For High Speed Cutters	
For Carbon Cutters decrease about 50%.	

Figure 88. Table of Cutting Speeds

meter of the work, the required R. P. M. can be computed. However, the various R. P. M. which are available on the particular machine on which the operation will be done is indicated on a table (see Figure 86). Rarely, if ever, are the required and available R. P. M. the same; therefore, it is necessary to use the available one next lower than the required. The feed depends upon the nature of the work, the cutting speed, the depth of cut, the accuracy and the finish required and the cutting tool used. The best feed corresponding to this cutting

speed is, likewise, made known from a chart. The available feeds on the particular machine in question are indicated on a table (see Figure 86). Again, the desired and the available feeds on the particular machine are rarely if ever the same; therefore, use the next lower available feed. This selected combination of available speeds and feeds is the nearest to the ideal that can be obtained. The "time" in minutes required to complete a given cut or "cutting time" is then easily computed from a table (Figure 86) or may be computed as follows:

$$\text{Cutting Time (to complete cut)} = \frac{\text{Length of cut (in inches)}}{\text{Feed per Rev. (in thousandths)} \times \text{R. P. M.}}$$

The "time" thus calculated is nearer the actual time required for performance of the job than is the shop estimate, and is quite satisfactory to use for the purpose of routing and scheduling. In factories where there are two or more machines of the same kind, care should be taken that the maintenance division makes the installation of these machines so that all of them will have the same capacity. This facilitates routing, scheduling and dispatching and makes the system of control more flexible as work can then be routed and scheduled to groups instead of single machines.

Machine Arrangement and Layout.—This leads to the problem of the best arrangement and layout of machines.[2] The two basic methods are: (1) where machines of the same type and capacity are grouped in a separate department or location; (2) the straight line or unit arrangement which provides for definite channels of complete processing of the part, that is, machines, irrespective of type, located in succession of the sequence of operations as they occur during the manufacture of the part.

Each method has its advantages [2] and disadvantages. As to which is the better, it depends upon the requirements of the particular plant in question and cannot be decided upon until a complete study has been made of all influencing factors. In a great many factories a combination of both types will be used. No two factories have exactly the same manufacturing requirements, but in every plant there is an arrangement which is best adapted to the conditions of

[2] See Chapter VI.

that plant. The arrangement adopted also has an important influence on the design and operation of the planning system, hence if the best results are to be obtained, a definite decision as to machine arrangement must be made.

Sequence of Operations and Standard Time for Each Operation.—Having decided on the best method of making the product, the available machines on which each operation will be done, the special equipment required and the arrangement of the machinery, the next steps are to decide on the most economical sequence of operations and then determine the standard time required for each operation.

Considerable experience in shop practice is necessary in order to be competent to lay down the proper sequence of operations and to determine the standard time for each operation. Vexing problems arise continually, the correct solution of which has a marked influence on operations and costs. Unless the work is done by an experienced shop man, wrong decisions are likely to be made.

Having decided upon the sequence of operations, standard time for the performance of each operation can be determined. This, too, requires considerable experience in shop practice, as will be fully appreciated after a study has been made of time study work in Chapter XXIX. The problem here is to determine the standard times from the blueprint of the product and not by means of actual time study conducted in the shop. After the product goes into production, then if necessary, time studies may be made to check those formerly estimated.

Route Sheet.—When all the foregoing factors have been determined for all parts entering into the finished product, the next step is to draw up an operation sheet covering each part.[3] Frequently operation sheets are called route sheets, but in order to differentiate between the operation sheets originally drawn up by the engineering department as above referred to and the later refinement of the data on these sheets by the time study section after the product gets into production, it is these latter sheets which for purposes of this discussion will be called route sheets. Figure 89 shows sheets 1, 3 and 4 of a typical route sheet. Sheet 2 has been omitted for lack of

[3] See Chapter XIV, Engineering Department.

space. The information called for on a route sheet and the arrangement of the data will depend upon the particular needs of the factory in question, therefore it must be remembered that the route sheet form given in Figure 89, as well as all other forms shown, are simply illustrations of forms that have been used in certain factories with satisfaction.

A brief explanation of some of the headings on the route sheet shown in Figure 89 may be desirable. The illustration selected covers the manufacture of part #304974, "rear axle shaft" for an automobile. There were 28 operations necessary in making the shaft, therefore several sheets had to be used in order to write up the complete routing. When a complete routing cannot be typed on one sheet, then the sheets should be numbered to facilitate handling and filing. The heading DIVISION has reference to the division of the factory organzation in which the operations are to be done. In this case, "DIVISION B" indicates the forge shop and heat treat section, while "DIVISION E" represents the machine shops, and so on. If a part travels from one division to another in the course of its manufacture, separate sheets should be typed covering the routing in each division, but separate sheets are not necessary when the part is routed to different shops or sections within a division. When it has been found desirable to replace a part by one of an improved or new design, that information should appear on the route sheet, because frequently it is necessary to refer back to the routing of a part which has been superseded, or to indicate the part which supersedes the one covered by the routing shown. The headings "SUPERSEDES" and "SUPERSEDED BY PART" are for this purpose. In the case illustrated, part #304974 supersedes part #301572.

Copies and Changes of Route Sheets.—Route sheets should never be typed nor copied by any foreman or by anyone in any other office outside the time study section or whatever section whose duty it is to supply them. Unless such authority and responsibility are thus centralized, a great deal of confusion and trouble will follow. Only a sufficient number of copies of a route sheet should be made to supply each person authorized to receive them. If there is a change made in any operation, or a different standard time set, change in rate of pay or anything else which would require any change to be made on a route sheet, then no changes should be made in pen and ink or other-

PRODUCTION ROUTING SHEET Sheet #1 PART No. 304974

NAME OF PART Rear Axle Shaft DIVISION B (Forge & Treat)

SUPERSEDES 301572 SUPERSEDED BY PART DATE 5/8/28

MATERIAL #7 H.R. Chrome Nickle Steel ROUGH WGHT. 13.379 lbs. per pc. ROUGH SIZE 1½"Rd. x 28"long MAKES 1 PCS.

ROUTING No. 9 CANCELS ROUTING No. 8 DATE 4/24/28 FINISHED SIZE 30-19/32" long MODEL No. 20 PCS PER CAR T 2 R 2 S 2 C 2

Dept. No.	Oper. No.	Operation	Schedule No.	Machine No	Machine Type and Tool Description	Std Time Minutes	No of Men	Prod per Hour	Price per 100 Pieces
		From Dept. 33 stock.							
14	10	Shear .25/C			Shears		1	200 D.W.	D.W.
14	20	Roll			Eccentric Rl.	.95	Opr.	63	1.45
							Hlp.		1.30
14	30	Hot saw & upset diff. end		4"	Header & Hot Saw.	.44	3	136	
							Saw Opr.		.59
							Header Opr.		.67
							Heater Opr.		.59
14	40	Hot saw & upset hub end			Hot Saw & 4" Header	.44	3	136	
							Saw Opr.		.59
							Header Opr.		.67
							Heater Opr.		.59
8	50	Trim		#56	Punch press.	.25	1	235	.28
8	60	Grind			Grind jack	.7	1	88	.80
15	70	Treat $5.[illegible]/C			Furnace		2	16 D.W.	D.W.
8	80	Rattle .50/C			Tumbler		2	200 D.W.	D.W.
14	90	Rough straighten			Punch press	1.5	1	40	1.50
14	100	Center			Centering Mch.	.74	1	81	.86
14	110	Straighten $.50/C			Metl. Wood Pr.		1	100 D.	D.W.
		Inspect (Non productive) Deliver to Dept. 67 (E-Machine)							

Figure 89-A. Production Routing Sheet (Sheet #1)

wise, but that one sheet should be retyped accordingly by the time study section. Copies of the revised page of the routing should then be exchanged for the superseded one with each person authorized to receive them. In order to prevent any possibility of error, it is necessary to call in and account for all superseded sheets. Provision for recording the number of times a route sheet has been changed and retyped is made under the heading "Routing No." In the case illustrated in Figure 89, sheet 1 of the routing indicates that it is the ninth time changes have been made and the sheet retyped, while changes on sheet 3 have been made only six times. The reason for recording this information on the retyped sheet is that frequently it is desired to refer back to one of the former sheets for certain data.

All sections, shops, etc., within a division are given a number, and the number of the shop (or department as they are very frequently

PRODUCTION ROUTING SHEET Sheet #3 PART No. 304974

NAME OF PART Rear Axle Shaft DIVISION E (Machine)

SUPERSEDES 301572 SUPERSEDED BY PART DATE 7/8/28

MATERIAL #7 H.R. Chrome Nickle Steel ROUGH WGHT. 13.379# per pc. ROUGH SIZE 28" long MAKES 1 PCS.

ROUTING No. 6 CANCELS ROUTING No. 5 DATE 6/7/28 FINISHED SIZE 30-19/32" long MODEL No. 20 PCS. PER CAR T 2 R 2 S 2 C 2

Dept. No.	Oper. No.	Operation	Schedule No.	Machine No.	Machine Type and Tool Description	Std. Time Minutes	No. of Men	Prod. per Hour	Price per 100 Pieces
67-B	180	Grind spline end to 1.225" dia.x1-3/4"		18	14"Norton Gr.	.83	1	72	1.04
		(Limits plus or minus .003)			5130				
67-B	190	Hob spline end 10 splines 2-1/16" lg.			Barber Colm	8.34	1	28.8	2.08
		(Limits plus .002 minus .000 on			Spline (on 1 mch.)			(on 4 mch.)	
		pitch dia.)		14-	14736				
		(One man runs 4 machines)		15	13593				
				16	13591				
				17	13590				
67-B	200	Drill (1) #5 hole in end to about		38-	S.S.Dr.Pr.	.253	1	237	.255
		3/16" deep.							
67-B	210	Mill woodruff keyway 7/32"x5/32"		4-	Tol.Hd.Mill.	.47	1	127	.30
		dp. 1/2"radius 3/16" straight			8532				
		bottom. (Man also does oper.							
		#220 at same time.)							
67-B	220	Mill (1) 1/8"keyway .137"deep			Becker Mill.	1.50	1	40	1.00
		2-1/2"long.		3	1897				
		(Limits width plus or minus .0005)							
		Depth plus .007 minus .000)							
		2 pcs. at one time) Man also does							
		either oper.#230 or Oper. #210							
		at same time.							
67-B	230	Drill (1) #28 hole thru 7/8" stock		2	L & G Auto D.	.705	1	85	.80
		(Man also does oper. #220 at same time.)			13414				

Figure 89-B. Production Routing Sheet (Sheet #3)

called) in which an operation is done is indicated in the vertical column at the extreme left of the route sheet. Thus, the first four operations on part #304974 are done in the forge shop, department 14; the next two operations in the grinding or snagging room, department 8; the seventh operation in heat treat, department 15; then back to department 8, and so on, until the eleventh operation, the last to be done in Division B (forge and treat). The part is then delivered to department 67, Division E—machine. Note that a new sheet is started when the routing left Division B and entered Division E. Also note that the operations are numbered in sequence for the entire routing, regardless of what division, shop or department the part may pass through during manufacture.

Further details in regard to making out the route sheets will be taken up in Chapter XXIX, "Time Study."

PRODUCTION ROUTING SHEET Sheet #4 PART No. 304974

NAME OF PART Rear Axle Shaft — DIVISION E (Machine)

SUPERSEDES 301572 — SUPERSEDED BY PART — DATE 7/8/28

MATERIAL #7 H.R. Chrome Nickle Steel — ROUGH WGHT. 13.379# per pc. ROUGH SIZE 28" long — MAKES 1 PCS.

ROUTING No. 6 — CANCELS ROUTING No. 5 — DATE 7/7/28 — FINISHED SIZE 30-19/32" long — MODEL No. 20 PCS. PER CAR T 2 R 2 S 2 C 2

Dept. No.	Oper. No.	Operation	Schedule No.	Machine No.	Machine Type and Tool Description	Std. Time Minutes	No. of Men	Prod. per Hour	Price per 100 Pieces
67-B	240	Thread 1.574 dia. to 1-9/16-20 thd.		1-56	Landis Thd.	1.66	1	36	1.66
		x 3/4" long			9192-13584				
		(Limits pitch diam. plus .000 minus							
		.0045)							
67-B	250	Profile one end of 1/4" keyway		37	Whitney H.M.	.99	1	60	1.00
		.137"x about 5/8" long to square		38	7074				
		up depth at end							
67-B	260	Grind off surface on both		9-10	14" Norton Gr.	.72	1	84	.71
		ends of shaft.		11-12	1407				
				13					
67-B	270	Cancelled - Combined with oper. 260							
67-B	280	Thread 7/8" - 20 x 3/4" full thd.			Landis Thd.	.99	1	60.5	1.00
		(Limits pitch dia. .8390 plus		56-1	13584-9992				
		.000 minus .004							
		Inspect (Non-productive)							
		Deliver to Dept. 83 Stock For assembly in Dept. 10							

Figure 89-C. Production Routing Sheet (Sheet #4)

Grouping of Route Sheets Into Assemblies.—It should be remembered that in the manufacture of an assembled product the finished product may be composed of several major assemblies and each major assembly composed of several minor assemblies, and in turn each sub-assembly made up of two or more individual parts. Figure 90 shows sheet 2 of the routing covering a motor assembly. The motors are assembled on an assembly line. In every case, all sub-assemblies or parts entering into or which go to make up another assembly must be finished and passed by inspection, on hand and the proper quantity available at the place and time when assembly begins, otherwise serious and costly delays may result. It is necessary then, that the route sheets covering all parts entering into an assembly be grouped together. This will permit the scheduling of the manufacture of such component parts so that all of them will be finished

PRODUCTION ROUTING SHEET Sheet #2 PART No. Motor Assembly

NAME OF PART MOTOR ASSEMBLY — DIVISION E (Machine)

SUPERSEDES — SUPERSEDED BY PART — DATE 5-31-28

MATERIAL — ROUGH WGHT. ROUGH SIZE — MAKES PCS.

ROUTING No. — CANCELS ROUTING No. — DATE — FINISHED SIZE — MODEL No. 4 all — PCS. PER CAR 1 — T | R | S | C

Dept. No.	Oper. No.	Operation	Schedule No.	Machine No.	Machine Type and Tool Description	Std. Time Minutes	No. of Men	Prod. per Hour	Price per 100 Pieces
51	40	ASSEM. CRANK SHAFT & FLY WHEEL							
		ASSEM. TO CYLINDER BLOCK							
		REMOVE NUTS FROM BEARING CAPS							
		INSTALL CRANK SHAFT & REPLACE							
		BEARING CAPS							
		TIGHTEN DOWN NUTS ON BEARING CAPS							
		TRY FOR TIGHTENING OF BEARINGS							
		MOVE & REMOVE BEARING CAPS & OIL							
		BEARINGS & TIGHTEN NUTS & INSTALL							
		COTTER PINS							
		MOVE & INSTALL FRONT BEARING HOUSING							
		CUPS - INSTALL AUTO WASHER NUTS & WIRE							
		& 2 CAP SCREWS WITH LOCK WASHER				2.34	8	25.6	24.00
51	50	INSTALL CLUTCH ASSEM. TO FLY WHEEL				2.34	2	25.6	6.00
51	60	BURNISH CRANK SHAFT BEARINGS &							
		TRANSFER TO CONVEYOR ON CHAIN FALL				2.34	2	25.6	6.00
51	70	ASSEM. CAM GEAR SHAFT INDICATE &							
		INSTALL COTTER PIN				2.34	2	25.6	6.00
51	80	PINING VALVES					2		
51	90	BUILD MOTOR LESS OIL BASE				2.34	11	25.6	35.00
51	100	BURNISHING IN CONNECTING ROD							
		BEARINGS MOVE TO JACKS-RETIGHTEN							
		NUTS & COTTER PIN CONNECTING RODS.							
		INSTALL GASKET & OIL BASE WITH TEN							
		CAP SCREWS				2.34	6		19.00

Figure 90. Production Routing for an Assembly (Sheet #2)

and available when wanted. Such information may be obtained from the master parts list,[4] as it gives not only the part number or symbol of each part entering into an assembly, but also all sub-assembly numbers which enter into the finished product. When an assembly number is given on a parts list, the parts entering into that assembly are listed.

For illustration, part #300095 may be a steering knuckle arm, while part #3782 is a bushing. Pressing the bushing into the drilled hole in the steering knuckle arm would constitute an assembly and would be given an assembly number, say 300576. This assembly may require several more operations on it before being completed, at which time it may be combined with another part or some other

[4] See Chapter XIV, Engineering Department.

assembly, in which case a new assembly number would be assigned, and so on.

In this grouping of the route sheets, even though complete information is given on the master parts list, it will frequently facilitate and clarify matters if the parts list is drawn up in graphic form as illustrated in Figure 91.

In this example, the finished product XY is made up of part #30 and the sub-assemblies #10, 20, 40, 50. Sub-assembly #10 is made up of parts #5 and #6 and sub-assembly #4, which in turn is made up of parts #2 and #3. Sub-assembly #20 is made up of part #21, sub-assembly #22, and so on.

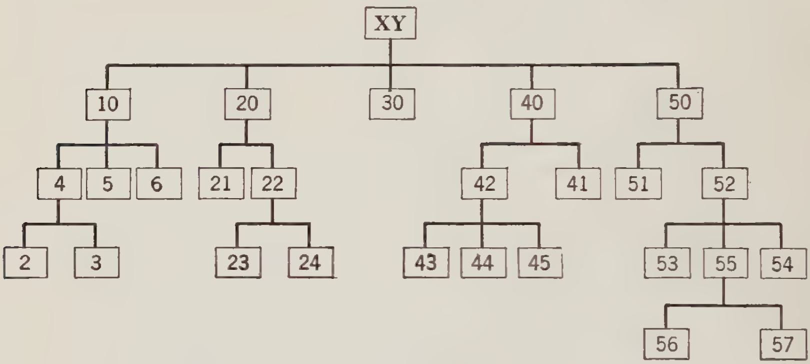


Figure 91. A Graphic Presentation of a Parts List

Such a graphic assembly chart showing the relationship between individual component parts of a finished product and the product as a whole may also prove helpful in drawing up a master time schedule indicating the last date on which production of the various parts must start so as to bring them through economically and have the complete article finished and ready for shipment on a specified date. A group of perhaps 500 route sheets is a rather appalling number to work with in drawing up a schedule. A graphic form as illustrated collects the information on one sheet and gives a clear and logical picture. This problem is discussed in the following chapter on scheduling.

Preparation of Tickets.—Having properly grouped the route sheets, the final step in routing is the preparation or writing of a set

of tickets for each lot of each part. These tickets are made out at the time the manufacturing order is issued and analyzed. The tickets are used, primarily, for giving out work in the shop and carrying out the routing and scheduling, thus facilitating production; secondarily, they are used for timekeeping and cost accounting purposes.

To serve these purposes, for example, in a concern producing in large quantities similar products but to customers' specifications, there should be a ticket giving all necessary information in regard to the material needed in the manufacture of the lot of parts so as to insure that the correct amount of materials will be at the place in the shop where the first operation is to be performed at the time when wanted. Other tickets should do likewise in regard to all tools and accessory equipment needed for each operation. Another ticket should accompany the lot of material from its issuance from stock through all operations to the time it is finally delivered to finished stores. Other tickets should give the workman on each operation all necessary information concerning his job, should supply all information needed by both the dispatcher and the schedule control man, and should show the location of the operation following the one covered by each ticket so as to facilitate the movement of parts or materials from operation to operation. Other tickets would authorize the movement of parts or materials from one operation or location to the next. Other tickets would provide for inspection reports, and finally, a ticket is needed to authorize the placing of the finished lot of parts in stores after the last operation and final inspection have been made. This set of tickets should also supply complete information for timekeeping and cost accounting purposes. A complete set of tickets, therefore, may be comprised of a stock requisition or stores issue ticket, tool tickets, an identification tag, work or job tickets for each operation, move and inspection tickets and material received from manufacturing orders tickets. These sets of tickets for each part are then filed by part number for future distribution by the dispatchers. The handling of these and other tickets needed to meet emergency and other conditions happening daily in the shop will be discussed in Chapter XXVII on dispatching.

CHAPTER XXVI

SCHEDULING [1]

Problem of Physical Routing.—After all details of routing have been completed, it is then necessary to set up some control mechanism for the purpose of making it easier to carry out and to control the physical problem of routing. There are certain fundamental principles upon which all production control methods are based, but due to the great variation in the manufacturing requirements of different concerns, there necessarily have been devised a large number of control systems differing in details of operation. Every industry and practically every plant within an industry necessarily requires its own individual control system to meet its particular needs. A complete production control system including control boards is necessary in some cases, while in others all that is necessary are a few simple charts or even a few written records. A control system to be effective should be so designed that it will facilitate production by directing the completion of work in process and that it will show at all times (1) the status of work in process of manufacture, (2) the amount of work ahead of the machines and other equipment and the unfilled capacity of various equipment which is available for the assignment of new work, and (3) the unfilled orders or demand.

The discussion in this chapter and the one following has purposely been given in considerable detail so as to bring out a variety of production conditions and to make the discussion broad in its application. All of the features covered would not be found in the average plant. To include all would involve a lot of "red tape." Certain ones will be needed in one plant, certain others in another plant, depending upon local conditions.

[1] Many of the illustrations, as indicated under the cuts in this chapter and the one following, are reproduced through the courtesy of the Warner Gear Company. The procedure of scheduling and dispatching as here discussed follows their methods to a considerable extent, the information being supplied by Mr. H. J. Wilson of that company. Their original control and production system was installed by Miller, Franklin, Basset and Company, Inc., of New York, and is explained in detail in Production Engineering and Cost Keeping, a book written by Mr. William R. Basset and Mr. Johnson Heywood, members of the above firm, and published by McGraw-Hill Book Company, Inc.

Scheduling.—In Chapter XXIV it was stated that scheduling is the determination of the relative time at which each operation or event in connection with manufacturing will occur. This will cover the determination of all times involved, from the time required to secure the necessary raw materials to the time required for final assembly. It was also stated that the mechanism of scheduling must be such as to provide flexibility of operation to meet all emergencies and irregularities.[2] With this definition of scheduling in mind, the problem resolves itself into the setting of the day of the month and frequently the hour of the day at which each event or operation in manufacturing will occur. For example, take a sewing machine, an automobile, or any other product which is made up of individual parts brought together to make sub-assemblies, these in turn being assembled to make other sub-assemblies, and so on, until the final assembly when the product is finished (see Figure 91). Knowing the date from the sales order or some other source on which the product or a lot [3] must be completed, it would be necessary to figure back and set a definite date and time at which work on each assembly must start and when each must be completed and on hand; the time at which each part entering into an assembly must be completed and on hand, regardless of whether the part is made in the factory or the completely finished part is purchased from an outside source; the time at which production on each component part to be manufactured must start; the date on which raw materials for all parts made in the shop must be delivered; and the date on which purchase orders, whether for raw materials or finished parts, must be placed. So as to insure delivery of the finished product on the date set, sufficient time must also be allowed for materials or parts to pass through either rough or finished stores or both, as the case may be. In this way the starting date of each event or operation can be determined.

Again referring to product XY in Figure 91, the time in days or hours required for the final assembly, that is for assembling together part #30 and the major assemblies #10, #20, #40, #50 to make the finished product XY, is obtained from the route sheet covering

[2] Definition by George D. Babcock, Management's Handbook, p. 637.

[3] A lot is the number of units that permits of most economical production. In some cases several small orders may be combined into a single lot; in other cases a large manufacturing order may have to be broken down into a number of lots. A number of factors enter into the question of the correct size of a lot. The cost, bulk and perishable quality of materials used, the cost and time required for machine set-up, the time required for operations, the space available for production purposes and for storage, all must be taken into consideration. Ordinarily it is desirable to have as large a lot as possible within practical limits.

final assembly. This time multiplied by the number of products in the lot would give the total time required for final assembly of that lot. By applying this time to calendar dates, the number of working days ahead of completion of final assembly may be checked off on the calendar, and the date on which final assembly must start is determined. Similarly, with assembly #10 and so on, until finally the dates are set on which production on parts #2 and #3 must start. The latest dates on which purchase orders covering the materials used in manufacturing these parts can then be determined. In all cases the necessary time allowance, if any, for rough and finished stores also must be included. A similar procedure is followed in regard to all other assemblies, parts and materials entering into the finished product.

When a production order has been authorized and definite dates determined for the starting of each operation or event, then purchase requisitions, stock issue tickets, job or work tickets, etc., which have already been made out should be dated to correspond with the schedule. The handling of these will be described in our discussion of dispatching in Chapter XXVII.

In a plant operating under mass production or manufacturing in large quantities only one or two or possibly a very few standard products, scheduling is more simple. Under such conditions raw material is issued in standard size lots and in certain departments or sections it passes from operation to operation, following a standard route. A change in machine set-up may not be required for months and there would be no need for the issuance of work and certain other tickets. In such cases, the time and the amount of work done by each worker or group of workers, as the case may be, are kept on individual time cards or group time cards.

After scheduling the work, in order to secure proper control so as to insure that the schedule will be carried out, it is necessary to follow actual production by continually checking it against the schedule. There are several ways in which this can be done. One way is by means of a progress sheet on which is transferred the routing from the route sheet. On the progress sheet there are also provided spaces and columns for entering other data, among which is a column in which is entered the number of work days ahead of delivery of the final finished product each operation or event should start, also columns for each lot with sub-columns in which is recorded

the actual progress of the work through the various operations. The latter is done by drawing a vertical line and by entering the date after each operation in the respective sub-columns. In this way, when all operations have been completed this series of short lines drawn after each operation will form one continuous line through all operations on the progress sheet. All progress sheets for one product or model are kept together. One method used is to carry the sheets on aluminum leaves which open like a book. The series number and the date due in finished stores or at assembly are shown clearly on a tab on the leaf.

Another way of scheduling work and checking the actual progress of the work against the schedule is by means of a schedule-control chart (Figure 93).

The Master Schedule.—An illustration will make clear a method used in scheduling. We will consider a plant manufacturing in large quantities products of the same general character or line, some of

Parts - Schedule			Month, *May 1928*								
Assembly or Model No.	Part No.	Per Job	Total parts required on dates indicated.								
			2	7	13	19	25				
20	304974	2	800	800	800	800	800				
20	300095	1	400	400	400	400	400				
20	300675	4	1600	1600	1600	1600	1600				
20											

Figure 92. Parts-Schedule Form

which are the company's standard designs and others are made to customers' specifications. The shop is highly planned. It is known what and how much to make and the dates of delivery for at least two or three months in advance. Included in the monthly orders of such a concern there probably would be two or more calling for the same model or product. The planning section would gather together all orders calling for delivery during a certain month and would group those calling for the same model or product so they can be readily totaled. In most cases, for various reasons customers prefer to have their monthly requirements delivered to them at regular intervals

during the month rather than to have the entire month's requirements arrive in one big shipment. Assume that during January one of the orders received calls for 10,000 of the product known as model #20, to be shipped at the rate of 2,000 per month commencing in May. After studying conditions, the planning section decides to make the monthly shipments in 5 equal instalments of 400 each at intervals of approximately every 5 working days, say on May 2, 7, 13, 19, 25. All other orders for May shipments are treated in a similar manner. In this way a master schedule for the month is prepared.

This master schedule is for complete and finished products, therefore, for manufacturing purposes it is necessary to reduce the master schedule to parts schedules (Figure 92). The basis for a parts schedule is the parts list for the respective products being manufactured.

The Schedule-Control Chart.[4]—For convenience in record keeping and to facilitate control it is desirable to refer to the total quantity of parts scheduled for each date by individual groups. Therefore, each such group will be referred to as a series and each given a series number. Thus, in May (Figure 92) there is a total of 5 series. In order to secure still closer control, each series is broken down into lots of equal size, that is, the same number of parts in each lot. Theoretically, each lot travels through the processes separately, but in reality there is a steady flow of work, one lot after another for an entire series. The size of a lot will vary, depending upon the number of parts in a series and other factors.

From the finishing date of a series, such as May 2, it can be figured back so as to determine the starting date of each series of all parts. This may be done by means of a schedule-control chart. These charts are drawn on suitable cross-section paper or other paper properly ruled and blueprints are then made. Inasmuch as each series has a starting and finishing date of its own, it is necessary for control purposes to have as many copies of the schedule-control chart as there are series. As in the case when the progress sheets are used, the charts for each product or model are kept together, each plainly labeled and indexed, ready for instant reference.

Figure 93 illustrates a schedule-control chart. The general method of procedure in drawing such a chart is simple. However, accuracy

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[4] The discussion of the schedule-control chart and the chart shown are adapted from Production Engineering and Cost Keeping, by Basset and Heywood, McGraw-Hill Book Company.

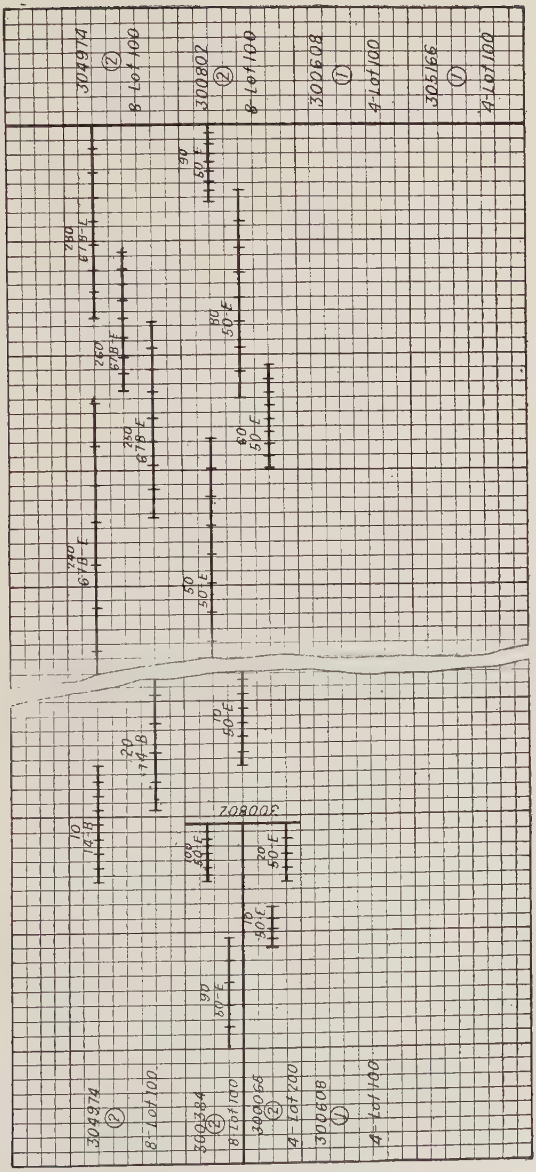


Figure 93. Schedule-Control Chart

is important, and this requires clear, straight thinking. In the column at the extreme right are listed the part numbers or sub-assembly numbers as the case may be, and under each is written the number of pieces required for one completely finished product or model, the number of lots in a series, and the number of pieces in a lot. Similar information is given in the column at the extreme left of the chart. The heavy vertical line at the extreme right of the chart represents the finishing date of the series and separates the column in which the numbers, etc., are listed from the rest of the chart. In the case in question the heavy vertical lines of the cross-section paper represent working days, each day being divided into hours as represented by the light vertical lines. The heavy horizontal lines are merely for the sake of clearness in keeping separate the graph representing each part or sub-assembly as the case may be.

How to Draw the Schedule-Control Chart.—For illustration purposes assume that part #304974 (see Figure 89) is one of the parts used in the product in question. This part is found listed on the parts schedule form covering the product (see Figure 92). It is noted that 800 of these parts are required in each series. The planning section has decided to put these through in lots of 100 each. On referring to the route sheet covering this part (see Figure 89), it is noted that the standard time required for doing operation #280, that is, the last operation prior to delivery to the finished stockroom, is 0.99 minutes per piece. There are 100 pieces in a lot, hence it will take 99 minutes or 1.65 hours to complete one lot, or 13.20 hours for this series. Beginning at the vertical line at the extreme right (see Figure 93), lay off toward the left 13.2 hours and divide this as shown on the chart into eight equal parts to represent the eight lots.

As already explained, the lots in a series follow one another through an operation in a continuous flow without requiring a new or different machine set-up. Therefore, no time is allowed or lost between lots, but as work passes from one operation to another sufficient time must be allowed for trucking the work from one machine to the next. Also, after certain operations the work should be inspected before the next operation is permitted to start. Therefore, a sufficient amount of time should be allowed between operations for trucking and for inspection when necessary. The length of time which it is necessary to allow varies with the local conditions found in

the individual plant.[5] The longer the time allowed, the larger will be the quantity of work piled up between operations, hence the greater the flexibility in production, as the larger quantity serves as a bumper or a reservoir to draw on for the following operation, should there be a breakdown or some other delay on a previous operation. This, however, runs up the quantity of material or parts in process, and hence may be costly. In the case in question, assume that local conditions are such that four hours' allowance is necessary.

From the route sheet it is noted that the next to the last operation, that is, operation #270, is cancelled, so no attention is given to it. Operation #260 requires 0.72 minutes per piece or 1.20 hours per lot and 9.60 hours for the series. Now the question arises, when should operation #260 start in order to eliminate any loss due to unnecessary idle machine time and idle direct labor time? It must be remembered that work is trucked from one operation to the next in lots only, not in any smaller quantities. Operation #280 is a slower operation than #260, hence it can start immediately after the first lot on operation #260 has been finished.

Therefore, at the starting point of operation #280 lay off toward the left four hours for allowance for trucking, etc., and this point will indicate the finishing time of the first lot on operation #260. Mark off 1.20 hours to the left of this point which will give the starting time for the series on operation #260, and from here lay off to the right 9.6 hours divided into eight equal parts to represent lots and the series for operation #260. From the route sheet the standard time for operation #250 is 0.99 minutes per piece, which means 1.65 hours per lot and 13.20 hours for the series. However, this operation is slower than operation #260, hence if operation #260 should start immediately at the completion of the first lot on operation #250, the

[5] In automobile plants and other factories on large-scale production, the quantity of certain parts going through and the operations necessary in their manufacture are such that machinery in certain shops or sections is laid out for progressive manufacture (that is, straight line layout), and there is a constant stream or flow of parts in process. Enough slow machines are installed to feed material to the faster type so that the entire line is balanced and speeded to the required output. With floor inspection and with trucking between operations thus reduced to the mere transfer of materials or parts from one machine to the next adjacent machine, it is not necessary to allow any time at all between operations. In fact, in many cases, conveyors or other mechanical handling equipment not only move the material but they automatically schedule production. The rate at which the processed material and parts should come through is first determined, and the materials delivered to the conveyors at that rate. The mechanical equipment then maintains the schedule of production set. In the manufacture of the part given on the route sheet illustrated in Figure 89, no time was allowed between operations, except when the parts are transported from one division (Division B) to another (Division E). However, in our discussion, for illustration purposes we are assuming a period allowed between operations for inspection and trucking.

operator on #260 would shortly run out of work and would have to wait until the next lot was delivered from operation #250. Therefore, in order to prevent this delay, the last lot on operation #250 should be completed at the time work is started on the last lot of operation #260.

Hence, from the point on the chart indicating the time at which work begins on the last lot of operation #260 lay off toward the left the four hours allowed between operations, and this point will indicate the time at which all lots on operation #250 should be completed. From here lay off toward the left 13.20 hours, which gives the time at which operation #250 should start, and so on, until the starting date of the first operation on the series has been determined. This last date shows what the status of rough stock should be at that time for the part in question. To determine the calendar dates, start at the heavy vertical line at the right and mark on it the finishing calendar date. Work backwards with a calendar allowing for holidays, and the starting date and hour of each operation can be readily determined. By treating all other parts and assemblies in like manner, the required information can be determined in regard to them. The figures above the lines in the chart indicate the operation number and the department or shop in which the particular operation is performed. Referring to the column at the extreme left of the chart, note that part #300384 travels through 10 operations and part #300065 through 2 operations, at which time they are assembled, the assembly under its number (#300802) continuing to travel through 9 more operations before it is completed and sent to finished stores.

Schedule-Control Chart is a Guide.—There are bound to be machine breakdowns, men unexpectedly absent from work or possibly quit and other daily happenings in the shop which may cause delays, therefore, it could hardly be expected that the schedule set by the schedule-control chart will always be lived up to. As may be expected, actual production may deviate from the schedule, but as soon as it does, every effort must be made to relieve the situation and to catch up with and again operate on the schedule. The schedule-control chart is not a hard and fast rule which must be followed regardless, but rather a working guide. It indicates the latest date and time at which the various operations or events should start in order that the work may come through as required.

Machine Load.—When the subject of routing was taken up in Chapter XXV it was mentioned that in order to get any degree of accuracy and to attain the best results in scheduling, it is necessary to know the capacity of the machines and equipment for doing work. For example, assume that the plant in question operates on a basis of 44 working hours per week, then each machine or workplace has a capacity of 44 hours per week. As each new job is assigned to a certain machine during a given period, it reduces by that same amount the number of machine hours which are still available for assignment to other work. If the total amount of work in terms of hours assigned to a machine or a group of like machines during a certain period is more than the available machine capacity as expressed in machine hours, then the machine or group of machines, as the case may be, is overloaded and the amount of the overload must be carried over and assigned to that machine the next following period. However, if necessary, overload can be overcome in one of several ways, by working the required additional number of hours overtime for one or more days, by performing the operation in some other way which would cause the work to be routed to some other machine or by purchasing a new machine. The method which should be adopted will depend on whether the duration of the overload is for a comparatively short or long period of time.

A machine load record is made out for each shop, section, room, department, or whatever the terminology may be in the plant in question. It is a record of all machines and workplaces in a section or shop showing the amount of work in terms of hours which has been assigned or scheduled to each for a given period. It also shows the amount of time still available, if any, which may be assigned to other work. Figure 94 is an illustration of a machine load record.

Machine Load Record.—The machine load record usually is made out in periods of one week for about one month in advance, while the schedule-control chart is made out for about two months in advance. When from the record it is observed that the machine load is falling off, it is an indication to the management that unless more sales orders are forthcoming they must then decide what orders to release to the factory for production to stock in anticipation of future sales, or else make preparation for a general lay-off of workers in those sections or departments where the machine load is falling off.

MACHINE LOAD

Shop 67-B
Date

Mach. No.	Part No.	Oper. No.	Lot Size	Time Hours			Mach. No.	Part No.	Oper. No.	Lot Size	Time Hours		
				Allowed per 100	Required	Balance Available					Allowed per 100	Required	Balance Available
Landis Threader						88							
1-56	304974	240	800	2.76	22.14								
	300802	50	800	2.00	16.00								
	305166	80	400	5.00	20.00								
	300608	75	400	6.00	24.00	5.86							
Whitney Hand						88							
Miller	304974	250	800	1.65	13.20								
37-38	305166	45	400	3.00	12.00	62.80							

Figure 94. Machine Load Form

In order to see how the machine load record is made up, refer to the schedule-control chart in Figure 93. Assume that the last five days shown on the right hand side of the chart represent a certain week. It is seen that during this week operations #240 to #280 on part #304974 are scheduled to be performed, also operations #50 to #90 on part #300802, operations #250 to #275 on part #300608, and so on. First take part #304974. Note that operations #240 to #280 are all performed in Department 67B. From the route sheet covering this part (Figure 89) it is seen that operation #240 is done on a Landis Threader, either on machine #1 or #56, and from the schedule-control chart (Figure 93) it is seen that it required 22.14 hours to complete the series. Next, make entry in the proper columns on the machine load record form for Department 67B (see Figure 94). Likewise, operation #250 is done on a Whitney hand-miller, either machine #37 or #38, and it requires 13.20 hours to complete the series. Then make this entry on the machine load record. In the same way record the machine load for operations #260 and #280. Parts #300802, #300608, and so on, are handled in a similar way, care being taken that the load for each operation on each part is entered on the machine load record of the shop or department in which the operation is done. When all entries covering the operations scheduled on all parts for that week have been made, total the hours listed in the "Time Required" column and subtract from the "Total Available Time," so as to determine the balance of time still available, if any, on each machine or group of machines which may be assigned to other orders.

Layout or Machine Schedule Chart.—The schedule-control chart schedules work to operations, but in order to carry out the schedule in the shop it is necessary to go into more detail by scheduling the work to individual machines or groups of machines, as the case may be. This is done by means of a layout chart or a machine schedule chart as they are frequently called. A very complete way of drawing such a chart is by means of the Gantt chart method described by Wallace Clark.[6]

A sheet of cross-section paper or other paper is used which is ruled to represent working hours of the plant, the ruling depending upon the

[6] The Gantt Chart, by Wallace Clark, published by The Ronald Press Company, page 57. Figure numbers have been changed to prevent confusion with other figure numbers in the text.

average length of jobs. If they extend over several weeks, the wide columns represent weeks and the narrow ones days; if they run less than a week, the wide columns represent days and the narrow ones hours; if they last less than a day, the wide columns represent hours and the narrow ones fractions of hours.

All the machines or work-benches in a department or shop are listed on the left side of this sheet. When an order is received, a list of the operations through which the material is to go is looked up, if it is not already shown on the order. On the layout chart opposite the machine to be used, the first operation is laid out.

An angle opening to the right: indicates when the job is to be started.

An angle opening to the left: indicates when the job is scheduled to be completed.

A light line connecting the angles indicates the total time scheduled for the order:

The machine on which the next operation is to be done is looked up on the chart to see when it will be ready for additional work. The order is then assigned to this machine and the angles and the light line are drawn. This procedure is followed in laying out all the operations on that order and continued until all the orders are laid out.

In assigning work to machines it is necessary to know what progress has been made on the work already assigned. Accordingly, as daily reports are received showing the amount of work done, a heavy line is drawn under the light line:

If the work is exactly on schedule, the end of the heavy line will be directly under the proper date and hour. If the work is behind or ahead of schedule, the end of the heavy line will be behind or ahead of the date. In assigning a new order to a machine, if the work is ahead of schedule, the new order is placed over the old one (Figure 95) and the date of beginning is placed in advance of the date of completion of the old order.

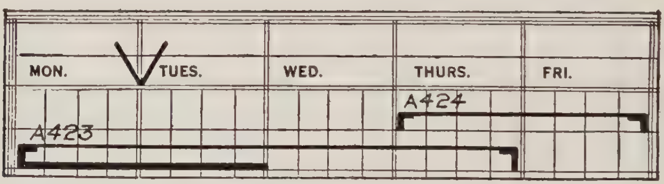


Figure 95. How Work Ahead of Schedule Is Shown by the Gantt Layout Chart

The V indicates the date on which the chart is copied. The work is 1 day ahead of schedule and conditions in the shop indicate that it will

be 1 day early in finishing. The new order, A424, is therefore laid out to be begun Thursday morning.

If the work is behind schedule, there is no advantage in planning to begin the new order until the old one is complete. Therefore, sufficient time must be set aside to make up for past delays before the new work can be begun. This is done by connecting the angles crossed lines (Figure 96).

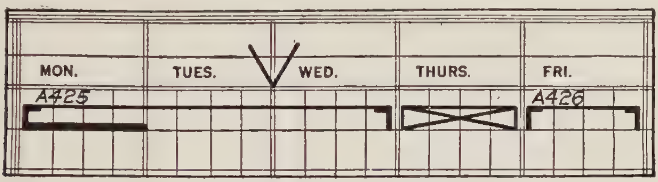
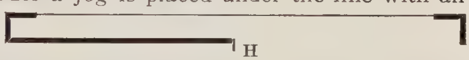


Figure 96. How Work Behind Schedule Is Shown by the Gantt Layout Chart

On the date indicated by the V, the work was one day behind schedule. Before assigning order A426, one day is allowed to make up for the delay and is indicated by crossed lines.

Above the light lines are written whatever numbers and quantities may be necessary to identify the orders.

When work stops on any order a jog is placed under the line with an initial to indicate the reason: 

The usual reasons are repairs, lack of help, material, power or tools, as shown by the legend accompanying Figure 97.

Figure 97 is a layout chart for a machine shop. This chart was drawn in a department equipped with large machine tools. On such machines only one job can be done at a time. On the first machine part # 1191-CE, according to the foreman's estimate, was to have been finished Tuesday noon, but had been completed on Monday, and another order was begun, #61427. That job was also finished ahead of estimate and the third order was begun Thursday afternoon instead of Friday. When the chart was copied on Wednesday, the 16th, the work was just on schedule.

On the second machine, the work was already 3 days behind schedule when it was carried over from a previous sheet. At that time order X6842 was scheduled to be begun Thursday morning and completed Monday afternoon, but it was necessary to run in a repair job, a ring for a motor, so that 4 hours had to be allowed for the delay (indicated by crossed lines) before #16842 could be begun. When the chart was copied Wednesday night, the work on this machine was 4 hours behind schedule.

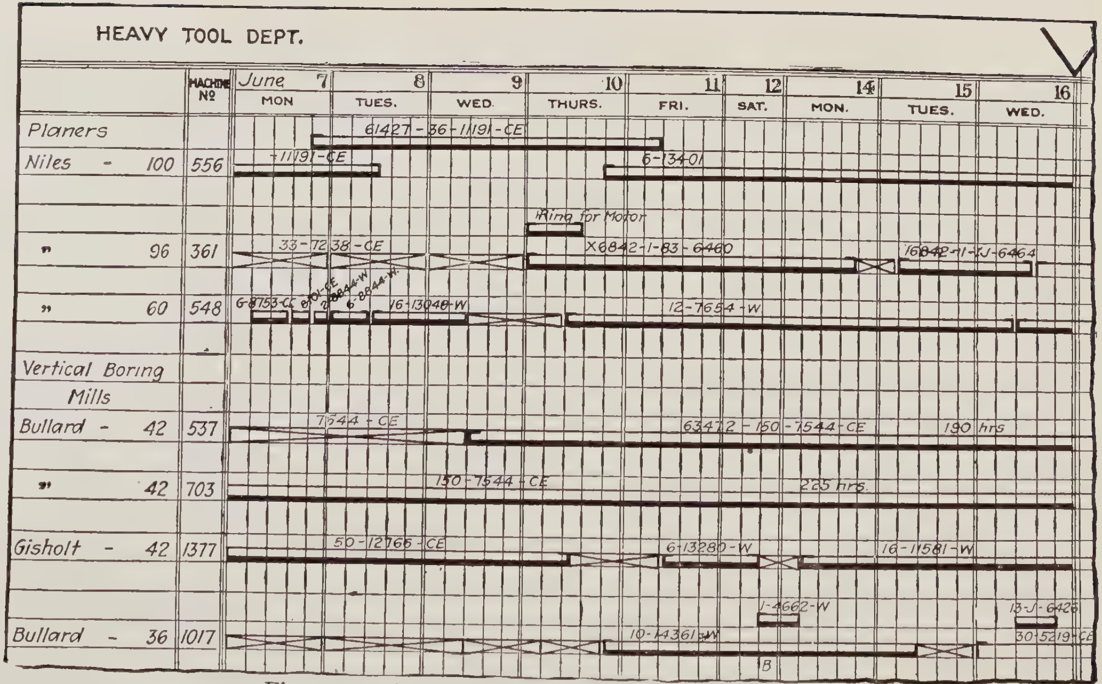


Figure 97. A Gantt Layout Chart for a Machine Shop

Date job is scheduled to start.
Date job is scheduled to be completed
Total time scheduled for order.
Work done.

Time required to make up for past delays.
Figures above lines indicate order numbers.
Indicates that chart was reproduced Wednesday night and shows how the work stood at that time.

Reasons for stopping work: *B*—Break-up. *H*—Lack of help. *M*—Lack of material. *P*—Lack of power. *R*—Repairs. *T*—Lack of tools.

This graphic layout makes it possible to group orders and distribute them over the available machines in a much more intelligent manner than by the hit-or-miss method of deciding what the next job will be whenever a machine runs out of work. When a machine breaks down, it is easy to transfer work from it to other machines without disturbing the proper sequence of work. When it is desirable to rush a certain order through ahead of other work, the use of a layout chart makes it possible to do so with maximum speed, because the chart visualizes not only the time required to do the rush order but also to get the other work out of its way. There is an added advantage in that the chart shows clearly how this rush order interferes with the work already in the plant and makes it possible to revise any promises which are likely to be broken.

Other Plants.—In a machine shop or textile plant, work is planned by machines (Figure 97), but in a foundry by floors, benches or machines (Figure 98). The chart for the heavy tool department (Figure 97) illustrates the planning of work for machine tools on which only one job can be done at one time. On drills with more than one spindle, on grinders with two wheels and other machines, it is possible to run more than one job at a time. On a molding floor in a foundry, for instance, the molder frequently works on several jobs in a day, the number depending on the importance of the work, the number of patterns he has for each order, the time necessary to put up each mold and the size of the floor.

On the molding floors in a foundry it is possible to do more than one order at a time. This makes the laying out of work different from that for machine tools as shown in Figure 97.

The layout chart for a foundry (Figure 98) shows how a variety of work or orders is planned for each man. On this chart the first molder, Conden, on floor #57, could put up molds for three orders each day. The chart indicates that he worked on order #5144 until Wednesday morning, when he was instructed to "break up" (indicated by B) and start on order #286. When he finished that he began on #341, but had to be stopped on account of lack of help (H) Tuesday morning, the 1st, when he went back to the first order, #5144, and did a day's work.

The second order, #5428, on which he was working on Monday, the 24th, went ahead until Friday morning, when he had to break up and begin order #5462, on which he worked until Monday morning when the absence of his helper prevented him from continuing.

On his third order, #5228, after 1 day's work he broke up and worked on order #300.

When the chart was copied Tuesday night, the 1st, Conden was so far behind the work already assigned to him that crossed lines had to be

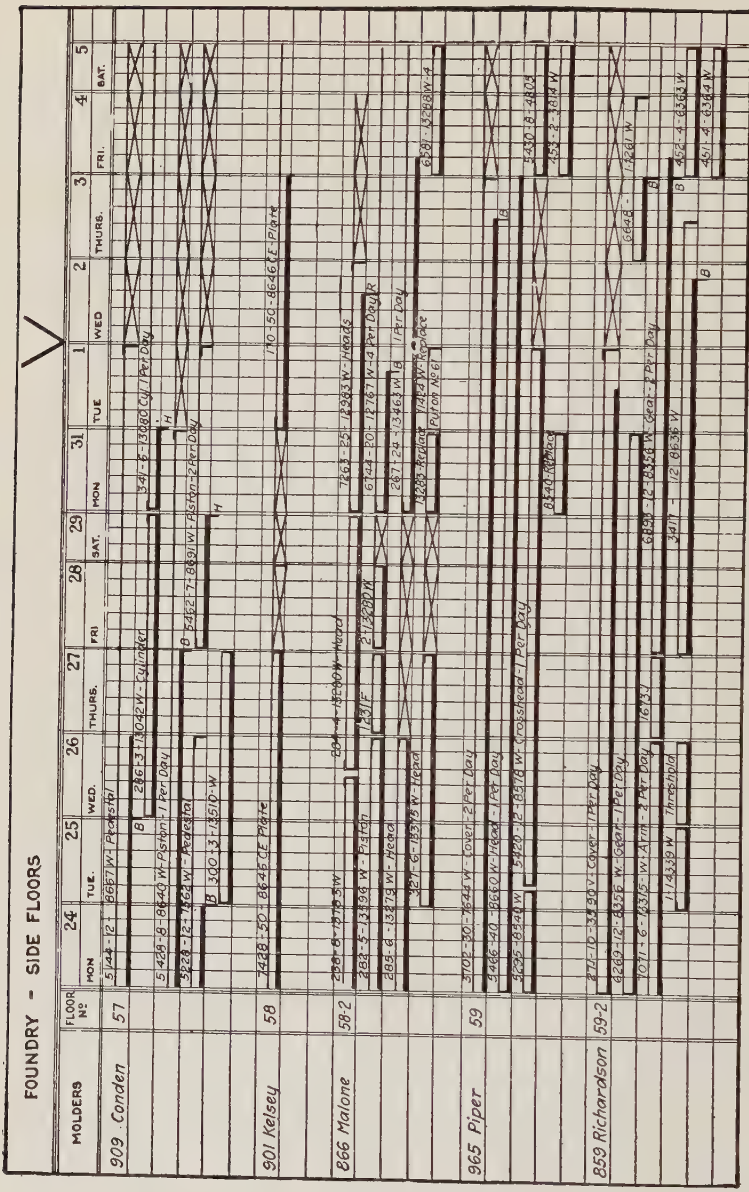


Figure 98. A Gantt Layout Chart for a Foundry

drawn through the remainder of the week to indicate that that amount of time would be required to make up for past delays before any further orders could be assigned to him.

The Gantt layout chart does not require any wall space, but can be used on a desk or table, kept in a drawer and carried around easily. Work is laid out in pencil and no expensive equipment is needed.

It is never necessary to erase anything from a layout chart unless a mistake has been made. If work has been laid out according to the best knowledge available at the time, and further information obtained at a later date makes a change advisable, the original plan is allowed to remain on the sheets and "Transferred to.............." is written over it. This makes clear all the steps taken and the reasons for changes in plans.

The Gantt layout chart helps to get work done because it makes clear who is to do any piece of work, when it is to be done, and how long it will take. It can be successfully made out only by one who knows what is to be done, how it can be done and how long it will take. Instructions based on this chart will, therefore, create confidence in the mind of the one who is to do the work. It is possible through this chart to assign definite tasks, and the more definite the task the easier it is to get it done.

Application of the Layout or Machine Schedule Charts.— The layout or machine schedule charts are made out for only a few days in advance, three or four or a week at the most, so that the daily happenings in the shop may be taken into account and proper allowance made for them in the scheduling of future work.

The layout or scheduling of work to the individual machines or workplaces would be done in a way similar to that described in drawing Gantt layout charts for a machine shop (Figure 97). From the schedule-control chart (Figure 93) it would be noted what parts are scheduled to be worked on during the next coming four or five days, and also what operations on those parts are to be performed during that time. From the route sheets covering those parts, for instance, part #304974 (Figure 89) it would be noted the shop or department and the exact machine or group of machines on which the respective operations can be performed and the allowed time for the performance of each operation. With this information, and knowing that under the conditions existing in the particular shop four hours are to be allowed between operations for trucking and for inspection when necessary, and also noting from the machine schedule chart already drawn and in use when the various machines and workplaces in the shop will

be available for the assignment of new or other work, it is an easy matter to draw up the machine schedule chart covering the work of the shop for the next several days.

Checking Actual Against Scheduled Production.—Each time a workman completes the operation he has been working on or changes to a new job he goes to the foreman's office or to the dispatch booth in his shop or section where his present job ticket is rung out and a new job ticket rung in and given to him. Even if a workman does not complete the operation at quitting time in the afternoon, he must turn in his job ticket just the same, so that a check of at least once each day is gotten on the amount of work completed by each person. This is necessary for several reasons which will be explained later. During the day the job tickets which have been rung out are collected every half-hour or hour, as the case may be, and delivered to the person in charge of keeping the schedule-control charts. Record is immediately made on the charts so that, practically speaking, the charts may be kept up-to-the-minute and thus at all time show the status of the actual progress of work in the shop. The information may be recorded on the schedule-control chart (Figure 93) in several ways.

For instance, assume that a job ticket covering the first lot on operation #250 of part #304974 is delivered to the schedule clerk. He may follow a somewhat similar method to that used with the Gantt chart. A heavy blue or red line would be drawn exactly below and of the same length as the light black line which represents the scheduled operation or lot corresponding to the job ticket just returned, or as in this instance, the first lot of operation #250 of part #304974. In a similar way, completed job tickets for each lot on all other operations on all parts would be recorded on the schedule-control chart. Instead of drawing a heavy line as just mentioned, the schedule clerk may simply check √ with a red or blue pencil the operation or lot as represented by the light line of the schedule-control chart, or possibly he may merely stick a colored-headed pin, similar to those used by the sales manager on his territorial maps, on the line representing the operation or lot, as the case may be. No attempt is made to indicate on the chart the actual length of time taken. By glancing down the vertical column which represents the current date, it instantly can be seen which of the last entries on the chart are behind

schedule. If any are behind schedule, every effort is used to bring the work up to schedule.

These same job tickets after being recorded on the schedule-control chart are used to keep the machine schedule chart up-to-date. However, this chart including the recording of progress of work is drawn and kept up by the methods described with the Gantt chart. When the progress line is drawn in on the chart, if the time it represents is more than a specified per cent behind the scheduled time for the same operation or lot, the foreman in charge of the shop or section where the operation is being done should be notified immediately, and he, in turn, should use every means to remove the cause and to bring the operation back up to schedule. It may be necessary to work overtime, or to start up an idle machine and reschedule part of the work to it or possibly temporarily hold up production on some part which is several days ahead of schedule and divert part of the lagging work to those machines thus temporarily released. One part coming through two or three weeks later holds up assembly and shipment of the finished product just that length of time, even though all other parts were completed on time.

These same tickets or a scrap ticket according to the method employed may be used for making entry on a "Production Check Sheet," so as to keep track of any spoilage or scrap that may occur at any operation during processing. The matter of replacing scrapped parts is handled in various ways depending upon the quantity of the product being made and upon local conditions in the particular shop in question.

CHAPTER XXVII

DISPATCHING

Making Routing and Scheduling Effective.—Routing and scheduling are of little value unless they are carried out. This is accomplished through the next step in production control, namely, dispatching. As defined, dispatching is the releasing of work and the directing of its movements in accordance with the route and schedule laid down for it. Dispatching in a continuous industry is comparatively simple, whereas it may be very complex in a job shop. The following discussion is based on the class of machine shop that is most commonly found in industry—one which manufactures the same general kind or class of products in quantities, some to their own specifications and others to customers' specifications.

It has already been stated that a schedule is more of a guide to the production organization than anything else. Machines break down in every shop at one time or another, men quit due to sickness, or for some reason do not come to work for a day or more, sometimes the operators do more work than was estimated would be done according to the standard time set for a task, at other times they do considerably less than was expected and many other things may happen at any time in the shop, therefore a rigid schedule is not practical. To be effective the method of dispatching must be readily adjusted to changing demands and so be capable of caring for rush and emergency orders and the many day by day happenings in the shop. It is evident, then, that there must be very close contact between the shop and those in charge of dispatching. This is where failure often occurs, as those doing the dispatching may issue impossible orders due to not being in close touch with or not knowing what is going on in the shop. One way of maintaining the necessary contact and of successfully carrying on dispatching is by the planning station or production booth method.

Jurisdiction Over the Production Booth.—In order that the man in charge of the actual giving out of the work in the shop be in

close touch with the current happenings in the shop thus enabling him to be in sympathy with the foreman and permitting of the closest cooperation between the shop and the planning and scheduling section, he is located either in the foreman's office or else in a small planning station or production booth built on the shop floor in a central location so as best to serve the shop men. The number of booths required varies with the volume and nature of the work done and the plan of organization and supervision under which the shops operate.

Dispatching is purely a service function primarily to facilitate production and to assist the line men, the foremen, to get out the work. However, in carrying out this function the same tickets used will also supply the accounting division with far more accurate cost figures, and more promptly too, than is possible under common practice, hence the tickets are used, secondarily, for cost and payroll purposes. Dispatching being a service function, the man in charge of a booth must carry on his work in such a way as not to interfere in any way with the rights, privileges, or prestige of the foreman, and yet at the same time the foreman is not permitted to ignore the work of scheduling and dispatching as it is his duty to see that work is turned out in accordance with the schedule in so far as it is within his power. It is evident then that a booth man should be under the jurisdiction of the foreman only in so far as discipline in his shop is concerned. The foreman usually is the one who knows of impending trouble or breakdowns, therefore, the booth man should be guided in the giving out of work by the foreman's suggestions. It is quite evident that a well-qualified booth man must use diplomacy and should have an abundance of good judgment. If an argument or dispute should happen to arise between the booth man and the foreman which cannot be satisfactorily ironed out between them, they should refer the matter to their respective superiors. Such conditions, however, seldom occur.

Inasmuch as the production booths serve two purposes, they should be under the joint control of both the production division and the cost division. The production division is represented in each booth by a production board operator. The cost division is represented in each booth by a time checker. Frequently one man does both jobs, in which case the man is directly responsible to the time section (cost division) but must operate the production board under

the direction of the central planning section (production division). In the discussion that follows, it is assumed that one man does both jobs and he will be referred to as the "booth man."

The Production Booth.—Whether the booth man is located in the foreman's office or in a separate dispatch booth, the equipment needed would be the same. A description of one of the booths used in one of the large automobile manufacturing companies will give a good idea of the general arrangement and construction of an average and very satisfactory production booth. A production booth is about 5 or 6 feet wide by approximately 8 or 10 feet long, with a wood floor raised about two or three inches above the shop floor. The front side and two ends of the booth for about four feet high are made of light tongue and groove sheathing above which is 6 feet of heavy ⅜ in. mesh wire. In one end of the booth is a door with a snap lock. The back is made of tongue and groove stock for the full height of the booth.

Mounted on the back is a production or dispatch board divided into sections, one section being allotted to each machine and workplace in the shop or that portion of the shop which is to be served by the booth. The assignment of sections should follow the layout of the shop as near as possible so that when the board is in use the assigned sections will represent a fairly true picture of the relative locations of the various machines and workplaces. Each section is divided into three compartments or pockets into which tickets may be placed.

Along the front wall of the booth is a shelf or counter and possibly three drawers, each attached to and underneath the counter. A half oval-shaped ticket window which can be closed and locked is cut out above the counter in the wire mesh screen. Here the workmen come to receive their work tickets and to return them when the job is finished. Mounted in a conspicuous place in the screen in the front of the booth is a small swivel wood panel or board about 10 in. x 12 in. in size with a stiff wire spring clip mounted on each side of the board under which tickets may be placed. This swivel board is called the "move board."

Also mounted at a convenient place on the front or end of the booth is the workmen's time card rack. The rack contains pockets arranged by workmen's clock numbers in which the workmen's "in

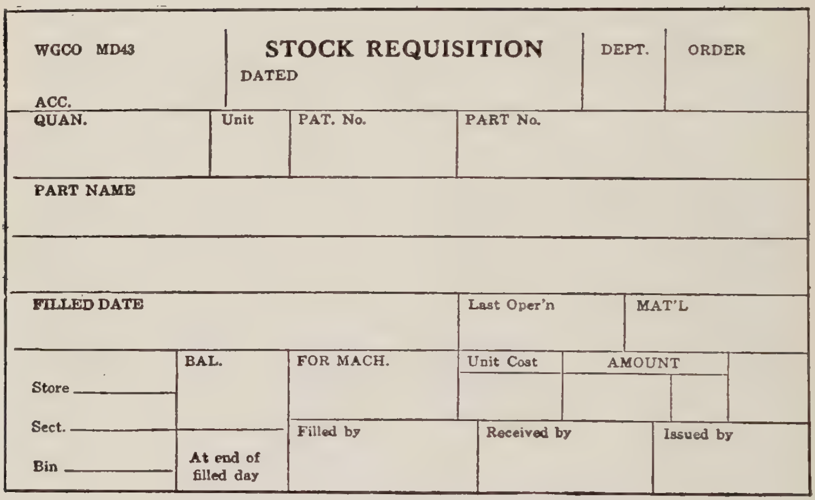
and out" time cards are kept. This board is also arranged on a swivel so that the rack can be turned to open toward the inside of the booth between the starting and quitting time, the rack being turned outward ten minutes before starting time and promptly at quitting time.

In the booth are two or three auxiliary visible files, a time stamp for clocking job tickets and others, a loose-leaf book containing copies of the route sheets for all parts worked on in the jurisdiction of the booth, a small amount of whatever office supplies may be needed and one high stool. The booth is painted a battleship grey. One side of the move board is painted a bright red and is known as the trucker's side of the board, while the other side, painted grey, is referred to as the booth side of the move board. The booth should at all times be locked and no one permitted to enter it except when on official business, and even then their business should be transacted as quickly as possible so as not to delay or interfere with the booth man's work.

Tickets Required.—The last element of routing, as mentioned in Chapter XXV, is the making out of a set of tickets covering each component part of the product or article. In manufacturing any part, rough stock must be ordered from the stockroom and delivered to the correct place in the shop; orders must be issued to the workmen for them to do each required operation; in many instances after the completion of an operation it is desirable to inspect the work before permitting the men to start on the next operation, therefore the work must be moved from operation to operation or to the inspection crib and back again as the case may be; care must be taken to have each lot identified from all other work at all time; and finally after completion of the last operation and final inspection, the finished parts which have passed inspection must be put into finished stores. A set of tickets covering these various moves must be made out for each part manufactured. This set of tickets would consist of a stock issue or requisition as it is frequently called, an identification tag, a work or job ticket for each operation as indicated on the route sheet, inspection tickets, move tickets and a "material received from manufacturing order" ticket which is used to put the finished part into finished stores.

Stock Requisition or Stores Issue Ticket.—The stores issue ticket authorizes the issuance of stock from the stockroom, and later serves as an order to move the material thus issued to the place in the

shop where the first operation on it is to be done. A copy of it serves to give the accounting division the information it needs in regard to the amount and value of the material used on that particular order so that proper costs may be determined. A copy informs the booth man and the schedule-control man that materials have been delivered to the shop, and also notifies the stock ledger clerk that the material has been removed from stock, hence is no longer available for future orders. This permits the clerk to make proper entries on the stock ledger, thus keeping it up-to-date. (See Figure 56). There may be


WGCO MD43
ACC.
STOCK REQUISITION
DATED
DEPT.
ORDER
QUAN.
Unit
PAT. No.
PART No.
PART NAME
FILLED DATE
Last Oper'n
MAT'L
Store
Sect.
Bin
BAL.
At end of filled day
FOR MACH.
Unit Cost
AMOUNT
Filled by
Received by
Issued by

(Courtesy of Warner Gear Company, Muncie, Ind.)

Figure 99. Stock Requisition Form

other purposes for which the stock issue form is used depending upon the particular requirements of the business, therefore, the data shown on the form necessarily will vary and will depend on the requirements of the particular concern. This same thing may be said in regard to all forms and routine explained in connection with routing, scheduling and dispatching.

The design of the issue ticket should be such as to provide spaces for entering at least the following information: the date the requisition was issued and the date filled; the order number or the purpose for which the material is to be used so that it can be charged to the proper account; the name and part number or symbol of the material;

the quantity; the cost per unit and the total value of the material issued; the location of the material in stores and the name and location of the first operation in the shop where the material should be delivered. Every time material changes hands it may be desirable to receipt for it, therefore, spaces may be provided for the signature (initials) of the persons who in turn issued the stock, trucked it to the factory and received it in the shop. Figures 52, 99, and 100 illustrate

MD-100 **ASSEMBLY REQUISITION** Book No............

Date Filled.. Page...........

Order No.	No. of Sets	Model No.

PART NO.	LOCATION		QUANTITY			CREDIT COST			Acct.	✓
	Sec.	Bin	Required	Filled	Short	Quan.	Price	Amount		

Counted by Checked by

(Courtesy of Warner Gear Company)

Figure 100. Assembly Requisition Form

three types of stock requisition forms, all of which have spaces provided for entering the basic information above mentioned and also other information required in the respective plants in which the tickets were used. The form given in Figure 100 serves the same purpose as the form in Figure 99 except that it is used to draw out full sets of finished parts for assembly into a final unit.

Identification Ticket.—In assembly plants each lot of material issued from the stockroom should be accompanied by some sort of

an identification ticket which should remain and travel with the material through all operations and inspections until the material or that lot of finished parts is finally put in the finished-stores room. Sometimes this is merely an identification tag with spaces provided so that entry can be made on it as to the amount and reason should any of the parts be removed from the lot on account of not passing inspection after some operation or be diverted to some other use than that for which they were originally issued. In other instances, it may show the entire routing and provide spaces after each operation shown

FOLLOW CARD INSPECTOR REPORT				No. 503						No. 503			
Order No.	Lot No.	Lot Quant.	Material							FOLLOW CARD Pay Roll Dept. Copy			
Part No.	Part Name									Order No.	Lot No.	Part No.	
Date Fin.	Clock No.	Oper. No.	Mach. No.	Quant. Good	Credit Oper.	Spoiled		Std.	O. K. Insp.	Date Fin.	Oper. No.	Quant. Run	
						Scrap	Reop.						
SPLITS (Quantity Sent Ahead)	Card No.	Date	Oper. No.	Quant.		O. K. Checker				O. K. Checker			
						Send to Inspector With Work				Send Daily to Pay Roll Dept.			

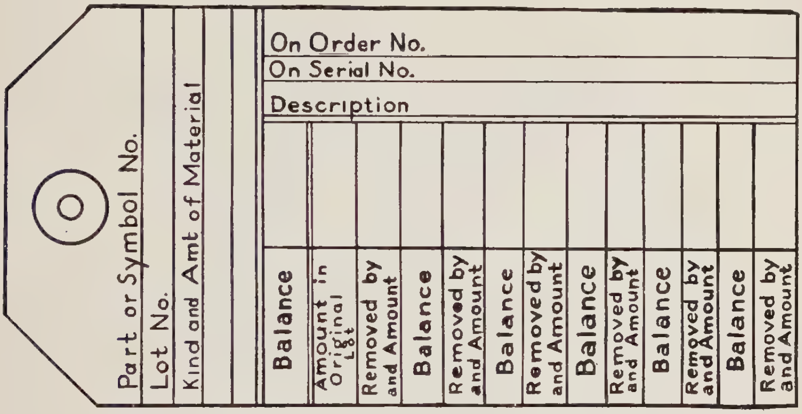
(Courtesy of Warner Gear Co., Muncie, Ind.)

Figure 101. Identification Card

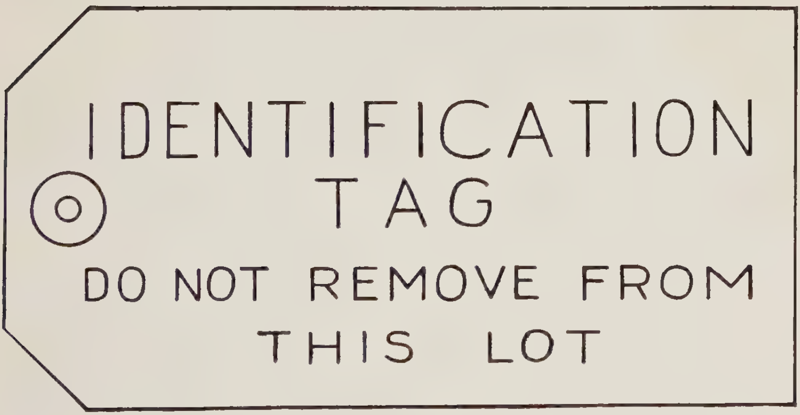
so that entry can be made indicating the clock number of the employee who did the operation, the quantity passed, rejected, scrapped and any other information required. Figures 101 and 102 are illustrations of two types of identification tickets. Note that a portion of the card shown in Figure 101 is for payroll purposes and that the card is perforated so that the payroll portion can be readily torn off to be sent to the payroll section.

Scrap Report.—When an inspector finds work which does not pass inspection he makes out a scrap report as illustrated in Figure

103. One copy is sent to the cost division for their records of loss due to spoiled work, a copy is sent to the production division to credit the planning section records, and a third copy is kept attached to the rejected pieces. Note in what detail the scrap report illustrated is



Face



Reverse

Figure 102. Identification Tag

made out. The scrap report acts not merely as a report of poor workmanship or material but as a warning of possible shortage of parts needed in assembly and of operating conditions which should be investigated and corrected.

MD 182 DATE RUN	SCRAP REPORT PROD'N DEPT.	PART NO.

MAN RESPONSIBLE		DEPT. RESPONSIBLE		MAT'L
OPER'N NO. COMPLETED		OPER'N NO. AT FAULT	OMITTED OP. NOS.	
CHANGE	OPE'RS	TO DEPT.	S. O. NOS.	
	OPER'NS			
FROM DEPT.		HAD MATERIAL EVER BEEN TO FIN. STORES		
CAUSE				
DEF. MAT'L				
INSPECTED		BY SALVAGE DEPT.		
DATE	BY	DATE	SIGNED	

QUANTITY				
REJECTED				
PASSED				
REOPE'R				
SCRAPPED				
VALUE SPOILED				
DEPT.	B.-P.	UNIT	COST	
MAT'L				

(Courtesy of Warner Gear Co., Muncie, Ind.)

Figure 103. Scrap Report

Work Order or Job Ticket.—These tickets are made out for each operation done on a part. They serve three purposes: first, to give the operator the information he needs in respect to "what" task has been assigned to him; second, to give the booth man the information he requires in carrying out his work and to permit the schedule man and others in the planning section to make proper postings on the several production control charts and records; and third, to supply the accounting division and payroll section with the information needed for costing purposes and for timekeeping so as to make up the payrolls.

In most cases the amount of an operator's pay depends upon the number of good pieces passed by inspection, therefore, in some instances the inspection report may be included in the information given on the job ticket. The ticket then would become a combination job and inspection report ticket.

In order to fulfill all of the above purposes, the design of the ticket should provide spaces in which at least the following information may be entered. For the operator assigned to the task, it should give him all the information he needs in regard to the work such as the part number or possibly the name of the part on which he is to work, the name of the operation, the operation number, the work-

place or machine number where the operation is to be done, the kind of material on which the part is made, the standard time allowed, the number of pieces wanted and the piece-work price. For the booth man it should give him complete information needed to facilitate and to carry out his work, such as the part number and possibly the name, the operation number and name, the workplace or machine number where it is to be done, the date and hour when the task is due or scheduled to start and the order or account number to which the work should be charged. Spaces should also be provided for entering the name or number of the workman who is assigned to do the task, the exact time at which the work was given out to the workman, and the time at which he stopped work, whether or not the task was completed when he stopped work for the day, and in either case how much was completed. To still further facilitate the work of dispatching it may be desirable also to provide a space on the ticket in which can be noted the location of the workplace or machine at which the next operation will be done.

If the job ticket is to be a combination job and inspection ticket, then for inspection purposes it should provide additional spaces for recording the number of good pieces or jobs which passed inspection, the quantity rejected and the reasons for rejection, the quantity which was rejected but can be repaired, the quantity which was scrapped in so far as that part is concerned, and a space for the inspector's O. K. and signature.

The data required for the purposes just described will also furnish all information needed by the scheduling section for keeping track of the progress, etc., of work and by the accounting division for costing and payroll purposes.

Move Order.—As a general rule, when an operation has been completed it is better to have the material moved to the next operation by a trucker than it is to have the operators do it for themselves. If it is done by an operator it takes him away from his regular work, causes idle machine time, gives a possible excuse for delays and unnecessary visiting with other operators and may lead to other undesirable practices. Usually this work is assigned to a move man or trucker. If the material is to be moved away from one shop or section to another, that is out of the jurisdiction of a production booth,

it is necessary to issue a move order authorizing the same. This ticket should provide spaces in which can be written a positive record of what and how much is to be moved, where it is now and to where it is to be moved, the date of issuance of the order and a space for the signature of the dispatcher as well as the person receiving it. Figure 104 is an illustration of a move ticket.

<table>
<tr><td colspan="6">MD 41
MOVE ORDER</td></tr>
<tr><td>ORDER NO.</td><td>LOT</td><td>QUANTITY</td><td colspan="3">PART NO.</td></tr>
<tr><td colspan="3">MOVE FROM</td><td colspan="3">DELIVER TO</td></tr>
<tr><td>DEPT.</td><td colspan="2">MACH.</td><td>DEPT.</td><td colspan="2">MACH.</td></tr>
<tr><td>DEPT.</td><td colspan="2">MACH.</td><td>DEPT.</td><td colspan="2">MACH.</td></tr>
<tr><td colspan="6">REMARKS</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="2">DATE</td><td colspan="2">SIGNED</td><td colspan="2">REC'D</td></tr>
</table>

(Courtesy of Warner Gear Co., Muncie, Ind.)

Figure 104. Move Order Form

"Material Received from Manufacturing Order" Ticket or "In Slip."—After the last operation has been performed and the parts inspected, a "material received from manufacturing order" ticket or "in slip" is used to put into finished stores those parts which have passed final inspection. The purposes for which this ticket is used are, first, to assure that nothing is received in the finished stores which has not passed final inspection, second, to notify the cost division of the quantity and value of material put into finished stores and, third, to notify the production division of the final quantity accepted in finished stores so that proper entry can be made on the schedule-control charts and other records, and if necessary replacement orders sent through to replace the material or parts finally scrapped. Figure 105 is an illustration of an "in slip" and serves the same purpose as the "materials received from manufacturing order" ticket shown in Figure 55.

Handling the Work in the Booth.—As previously explained, sets of the above tickets are made out at the time the manufacturing order is issued and analyzed. The tickets in each set are logically arranged, clipped together and filed by part number in the central planning office. In the central office there is a man whose duty it is, among other things, to watch the schedule-control chart and be responsible for starting the dispatching mechanism at the proper time. For example, he notes that a certain part is to start in production in

MD 42

IN SLIP

This slip carries FINISHED Parts into Finished Stock after being PROCESSED or RE-OPERATED in our plant	Date ________ 192

Quantity ____________ Part No.________________________ Kind Mat'l ________________

Name ____

Pattern ______________ Lot No. ______________ Re-operated, Yes or No ______________

If Re-operated, had material come from Finished Stores, Yes or No ____________________

Remarks ____

SEND TO DEPT. ____________________ Sec. ________ Bin ________ Balance __________________	Received by Storekeeper ______________ Signed Inspector ________________	Unit Cost __________________ Amount

(Courtesy of Warner Gear Co., Muncie, Ind.)

Figure 105. In Slip, or Material Received from Manufacturing Order Form

a certain shop or section on a stated date. Two or possibly three days before that date he will remove from the "parts to go in process" file the stock issue tickets, identification ticket, the job tickets covering all operations which are to be done in that shop or section over which the particular booth man has jurisdiction, and the move ticket, also the "materials received from manufacturing order" ticket if the last operation on the part is done in that same shop or section. The tickets are kept together in the same logical order in which they were originally arranged and are sent to the booth man in charge of the shop or section in question.

He removes the identification ticket and the stock issue tickets,

clips them together and files them in a temporary file by part number. The job ticket covering the first operation is filed in the third or back compartment on the production control board under the machine number on which the first operation will be done. If other tickets are already in this compartment this last set of tickets received would be filed back of those already filed. All job tickets for other operations on that part which were sent to him by the central planning section are handled in like manner. Tickets covering the job now being worked on by that machine are filed in the first compartment, while the tickets covering the job to be worked on next at that machine and for which the rough stock is now waiting at the machine are filed in the middle pocket.

Jobs for Machine #1105.—To illustrate how the booth operates, assume that the booth man looks at his production board and sees that there are no tickets in the middle compartment for machine #1105. This means that unless more work is immediately dispatched to machine #1105 it will be idle as soon as the present job now being run on it is completed and the operator too will be idle unless he can be transferred to work on some other machine. Such a situation is prevented by the booth man removing the first job ticket in the third compartment of machine #1105 on the production board and placing it in a temporary file under machine #1105. He notes the part number shown on the job ticket. Going to the temporary file in which identification tickets and stock issue tickets are filed according to part number, he removes the corresponding identification ticket and the copies of the stock issue ticket clipped to it and sends them to the proper stockroom. The stock clerk places the material called for on the stock issue ticket in a tote-pan, in a dolly box or on a truck, as the case may require, in accordance with the standard way of handling that particular part or material, along with one copy of the stock issue ticket and the identification tag. This is a signal to the trucker to move the material to the machine or workplace in the shop where the first operation is to be done as is indicated on the stock issue ticket.

As soon as the trucker delivers the material along with the identification ticket or tag at the designated place and has his copy of the stock issue ticket signed by the person receiving the material, he delivers the stock issue ticket to the production booth placing it under

the steel clip on the grey-colored side (the "booth" side) of the move board, then he goes on his way doing his work as usual. The booth man swings the swivel move board so that the "booth" side of the board faces the inside of the booth. He removes the signed stock issue ticket from the move board, which is a notification to him that the material is now waiting at the proper place in the shop where the first operation on that part is to be done. The booth man then takes all three copies of the job ticket corresponding to the signed stock issue ticket from the temporary file under machine #1105 and places them in the second or middle pocket on the production board for the same machine, thus indicating on the production board that the material for the next job which is to be done on machine #1105 is now waiting at the machine. He then sends this same signed stock issue ticket to the central planning section so they may make record on the schedule-control chart of the movement of the material and make proper entry on the other production control records. The copy of the stock issue ticket which the storeskeeper retained is used by him to make proper entry on the bin tags or whatever records may be kept in the storeroom, and then the ticket is sent to the accounting division for costing purposes.

It can be readily determined just what jobs are in the booth and their status. The job tickets in the first pockets on the production board indicate the jobs now being worked on at the respective machines or workplaces; the tickets in the second pockets cover the jobs to be worked on next at the various machines, the materials for which are now at those machines; the job tickets in the temporary file under machine numbers indicate the jobs for which stock issue tickets have been sent to the stockroom but the materials for which have not yet been delivered to the machines, and the identification tickets filed in the temporary file under part numbers show the jobs in the booth for which the booth man has not yet requisitioned stock. This also makes it possible readily to get out an inventory of work in process.

Set-Up Ticket.—If the next job ordered to be run on a certain machine is simply the same operation as is being done on the machine at the present time, no matter whether it be on another lot of the same series, a different series or a different part, there will be no necessity for changing the machine set-up. If the job to be run is different

from the one now running, the booth man writes out a set-up ticket which is an order on the tool crib to deliver to the machine indicated and not later than the time stated, the tools required for the new operation as specified on the ticket. This ticket is made out and sent to the proper tool crib before the job then running on the machine is finished. Local conditions determine the length of time in advance that the set-up ticket should be sent to the crib. If for any reason, such as lack of proper tools, the tool-crib man is unable to deliver the tools, he immediately notifies the booth man of the fact and the reasons why. This gives the booth man an opportunity to hurry and get another job lined up for the machine before the operation then running is finished. The ticket is made out in quadruple. The original is sent to the proper tool crib, one carbon goes to the foreman of the shop where the operation is to be done so that he, one of his assistant foremen or the set-up man, whoever has charge of such work, will know about the job and will be ready to make the set-up as soon as the present job on the machine is completed. A second copy goes to the inspection division so that an inspector will be present at the time the new job starts and inspect the first few pieces made. This will insure that the operation is running satisfactorily at the very beginning, thereby reducing the possibility of rejects and scrap. The fourth copy is retained by the booth man for his record.

How the Work Is Given Out to the Shop.—Assume that an operator has just completed his job. He goes to the production booth window and hands to the booth man his copy of the work ticket for the job he has just completed. From the first or outer pocket on the production board under the machine number corresponding to the machine indicated on the man's copy of the work ticket he just returned, the booth man removes the original and third copies which were filed there and "rings out" all three copies. Assume now that the operator is next to work on machine #1105 to which material for that next operation was recently delivered. The booth man removes all three copies of the job ticket from the second or middle pocket on the production board under machine #1105, rings them in and hands the first carbon copy (known as the operator's copy), to the operator who goes to machine #1105, compares his copy with the identification tag which is with the material in regard to part number, lot and series, and if they check he starts work on the operation. The booth

man files the original and third copies of the work ticket which he retained in the first or outer pocket on the production board under machine #1105.

How Job Tickets for Completed Operations Are Handled in the Booth.—Again referring to the three copies of the job ticket which were just rung out, the third copy (on rather heavy manila paper and called the inspection and timekeeping copy) is placed under the steel spring clip on the red or trucker's side of the swivel move board and the red side of the board turned to face toward the shop. This is a signal to the trucker to move the material indicated by the ticket either to the next operation or to the inspection crib, as the case may be. If to the next operation, the trucker after moving the material returns the ticket to the production booth placing it under the steel spring clip on the booth or grey-colored side of the swivel move board. If the material is to be taken to the inspection crib, the trucker leaves the manila copy of the job ticket at the inspection crib along with the material and the identification tag.

When inspection has been completed, the inspector makes entry on the manila copy of the number of good pieces which passed inspection, the number of rejects and scrap and the reasons why they were rejected. He also makes the same entries on the identification tag as well as entering the clock number of the operator or operators who worked on the lot. The trucker then moves the material to the next designated machine or workplace leaving the identification tag with it, and returns the manila copy of the job ticket to the production booth placing it under the steel spring clip on the booth or grey side of the swivel move board.

The booth man removes the manila copy from the move board and takes from the files the production and cost copy and the operator's copy of the job ticket corresponding to the inspection and timekeeping (manila) copy just returned and enters on them the inspector's report as appears on the manila copy.

Every half-hour during the day a messenger collects from each booth the original (production and cost) copy of all job tickets on which inspection has been reported and delivers them to the central planning section where proper record is made on the schedule-control chart, the machine schedule chart and other production control rec-

ords, and then this same copy is sent to the accounting division for costing purposes.

At quitting time at night the booth man checks the operator's copy of all job tickets of each operator for that day against the respective operator's "in and out" clock card so as to make sure that all the tickets are there and the total time registered on each clock card accounted for. He then sends the inspection and timekeeping (manila) copy of all job tickets to the timekeeping section for payroll purposes. If at quitting time the inspection report on work completed by an operator that day has not been returned to the booth, the booth man sends the operator's copy of that job ticket to the timekeeping section and the operator is paid for 100% of the work indicated on the ticket. The next day when the inspection report on the manila copy of the job ticket of that work comes to the booth man he holds it until quitting time and sends it along with the other timekeeping copies of tickets for completed work for that day to the timekeeping section. Adjustment can then be made in the operator's pay if necessary.

All Operators' Job Tickets Must Be Turned in Every Night.—If at quitting time an operator has not finished the lot he has been working on he makes note on his copy of the job ticket of the number of pieces completed and hands in the ticket to the booth man just the same as if he had completed the job. The booth man rings out the operator's copy and the inspection copy but does not ring out the production control and cost copy. The operator's copy of this job ticket along with the timekeeping (manila) copies of other job tickets of completed work for that day are sent to the timekeeping section as usual, and the inspection and timekeeping (manila) copy of this job ticket is placed on the trucker's (red) side of the move board. The booth man then makes out two additional copies of that job ticket, an operator's copy and a timekeeping and inspection copy, making note on them of the quantities not yet finished. These two additional copies of the job ticket are placed on the workmen's time card rack in the pocket under the respective workmen's clock number. When the operator starts work the next morning these two additional copies of the job ticket are rung in by the booth man and then are handled in the usual way.

When an Operator Must Stop Work on a Partly Finished Lot.—It may become necessary, due to a machine breakdown or some other cause, for an operator to stop work on a lot before it is completed. Assume that work on a lot has been stopped in order to let through a rush order. The operator delivers his copy of the job ticket of the lot which has been stopped to the booth man who rings out both that copy and the timekeeping and inspection copy. These two copies are handled the same as though the operator at quitting time had not finished the lot he had been working on, and as in such cases two additional copies of that job ticket (an operator's copy and a timekeeping and inspection copy) are made out with notation on them of the quantities not yet finished. He removes the original (production and cost) copy from the first or outer pocket on the production board under the machine number in question and clips to it the two new additional copies, then places all three in the second or middle pocket in front of any tickets which may already be in that pocket on the production board under the same machine number. This indicates that the material is at the machine and should be the next job to be done when the rush job is completed. The job tickets for the rush job going through are handled in the usual way as already explained.

When it Becomes Necessary to Split a Lot.—Under some circumstances it may become necessary to split a lot and rush through to completion a portion of it. In such a case a complete new set of tickets is made out for the number of pieces which are to be rushed through. If the original lot which is to be split is lot #1, then the portion of that lot which is to be rushed through is given a new lot number such as lot #1-A, while the remaining portion which is to come through in regular order as originally scheduled retains its old lot number. If necessary, the new lot #1-A may have a distinctive color tag attached to it marked RUSH—URGENT which would give it preference over any other work assigned to the same machine.

When a Lot Falls Behind Schedule.—Due to a breakdown of a machine or for some other cause a lot may fall so far behind schedule that there is danger later of its resulting in slowing down or holding up assembly. In order to secure balance in production and to prevent such delays, it is necessary to bring the lagging lot up to schedule. This may be done by attaching a BEHIND SCHEDULE tag to the lot

which would give that lot preference over all other lots of equal importance in the shop.

In case several lots fall behind schedule and one of these is urgently needed and must be rushed through even ahead of the other lagging lots, a RUSH—URGENT tag may be attached to it which would give this lot preference over all work assigned to that group of machines.

Idle Machine Ticket.—As previously explained, the production board in a booth represents the shop floor, each unit of three pockets on the board represents the equipment and the job tickets represent the work being done on that equipment or scheduled for it. The booth man should indicate at all times on his production board the work being done on the equipment in his section or shop. This means that at all times a production job ticket, a non-production work ticket or an idle machine ticket must be in at least one of the pockets of each unit. If there is no work for a machine or if the unit is idle for any cause, an idle machine ticket is made out in triplicate. The ticket should at least show the machine symbol, its location, the reason for its idleness, the time idleness started and a space in which to enter the time the machine is put into operation again. The original copy is sent as a notification to the person responsible for correcting the condition at fault. If the machine is idle due to breakdown, the maintenance division is notified so that the machine will be repaired immediately. The first carbon copy is sent to the central planning section for making notation on the machine schedule chart so that this may be taken into consideration in future scheduling. The third copy is retained by the booth man and placed in the front of the first pocket of the machine in question where it remains until that idleness is ended. When the idleness ends the booth man removes the idle machine ticket from the production board, time stamps it accordingly and sends it to the central planning section. A daily report of idle machine time and the reasons for it are forwarded to the production manager.

Placing Processed Parts in Finished Stock.—After the last operation on a lot has been completed and the manila copy of the job ticket with the inspection report on it has been returned to the booth man, the parts are ready to be put into the finished-stores room. The booth man enters on both copies of the "material received from

production order" ticket or "in slip" the number of pieces passed by inspection and places both copies of the ticket on the trucker's side of the move board. This notifies the trucker to deliver the material either to the designated finished-stores room or to final inspection as the case may be. Assume that in this case the parts go to final inspection. After final inspection of all pieces, if some are rejected during this inspection, the inspector crosses out the number of pieces entered by the booth man on both copies of the "material received from production order" ticket, and in place enters his final count of good pieces and signs both tickets. He also makes out a rejection ticket for those pieces not passed. The trucker then takes the material, identification tag and both copies of the "material received from production order" ticket to the designated finished-stores room. The storeskeeper verifies the count as indicated on the ticket and signs both copies. The original copy is sent to the planning section for entry on their production records and is then filed for future reference. After the storeskeeper has made entry on the bin tag and whatever other records his storeroom may keep, he sends the carbon copy of the ticket to the accounting division for cost purposes.

Application of Scheduling and Dispatching.—If all the features of scheduling and dispatching covered in this and the previous chapter were to be included in any one plan of production control there would necessarily be included a lot of red tape, which is what we are all trying to get away from in industry. For instruction purposes it is necessary to bring to light and work out all possible corners of a plan. The reader in developing a planning system for a particular plant can then select those features that adapt themselves to the needs of his plant, discarding those others which in his case have no "profit-bearing" virtue. For instance, the Warner Gear Company at the present time does not keep a machine load record in their factory planning system as their plant is 90% grouped in sequence of operations, and the number of sets of materials the lines are capable of producing is well known. In many factories, however, where runs are many and short, a machine load record would be indispensable. Similarly with many of the other features covered. In some plants the lot system must be strictly adhered to in order to keep material together in production centers. In other plants under different conditions this is unnecessary. Material can be started in lots of

a day's requirements, and through the aid of graphic charts production can be kept to the required daily schedule. Even within the same plant, the planning system may have to be developed along different lines in different sections or shops to meet their individual needs.

CHAPTER XXVIII

A PRACTICAL ILLUSTRATION OF DISPATCHING

The routine of dispatching and the forms required must necessarily vary with the needs of the particular concern and its surrounding conditions. The following which is an exact reproduction of the "Production Booth Instructions" as used in the Willys-Overland Company plant at Toledo, Ohio, is here given to show how dispatching is carried out in a large-scale production plant, and to illustrate the form and detail in which the instructions for carrying out such work are given to those directly concerned.

Willys-Overland—Production Booth Routine

The Booths are installed so the supervisory force of the Department can devote their time to supervising the Department, so it can be done more efficiently, and so that employees of the Department can come to the Booth to get the information in regard to the operations they are to perform and the prices they are to receive for the same.

On that account the men in the Booths to a certain extent are the representatives of the Company and in many cases are the only contact that the employees of the Department have with the Management. The Booths are something new to a great many of the newer employees and they do not thoroughly understand their use and the benefits that are to be derived from them.

The Booth Operator is in the same position as a clerk in a store and all the people that come to the Booth should be considered as customers and every effort should be made to give satisfactory service. With that end in view it is necessary that the Booth Operators have the knack of getting cooperation. It might be necessary to explain many times how the Booth functions, to have the necessary patience to listen to a man's complaint and have the ability to explain to him why certain things are done certain ways.

When the Booth is operated efficiently the men in the Department have confidence in the work that it is doing and are glad to cooperate with it so that there will be harmony in the Department.

The Production Booths are under the joint control of both the Production Department and Factory Accounting.

The Production Department will be represented by a Production Board Operator.

The Accounting Department will be represented by a Time Checker.

Should it be good practice to operate a Production Booth with one man, that man shall be directly responsible to both Departments. He will operate Production Board under direction of the Production Department and Time Checking under Accounting Department.

Responsibility of Booth Operator

The Production Board Operator is responsible for the correct operation of the Production Board; for the issuing of proper work tickets to the right workmen; for the correct report on pieces, part numbers, operation number, lot number, department number and machine or location number; for the handling of requisitions; move orders and storeroom receipts, for the reporting of any necessary information required by the Production Time or Cost Departments. On job tickets used for Sundry, Repair or Special Orders information is to be furnished as per instructions.

The Production Board Operator is responsible for all counts. He will indicate at all times on his board with a productive job ticket (W-27) and expense ticket (W-51-B), or idle machine ticket (W-38), the work being done on the equipment in his Department. He will furnish any reports requested through the Production Department and should always have a correct record of material and equipment in his Department.

Responsibility of Time Checker

The Time Checker is responsible for the time card rack being properly operated; for all clock ringings; all time extensions; all money extensions; all piece prices being correctly entered on job tickets; for the reporting of any necessary information required by the Time and Cost Departments, on job tickets used for Sundry, Repair or Special Orders and for the handling of "Charge Backs" and adjustment to the Time Tickets.

The Time Checker furnishes an audit of all reports which pass through his Booth to the Accounting Department. He will see that all tickets leave the Booth with the information entered as per standard practice, at all times have a record of how all men in his Department are employed, and furnish any reports requested through the Accounting Department.

Neatness and Efficiency

The Production Board Operator and the Time Checker are equally responsible for the neatness and cleanliness of their Booth; for giving

quick, accurate and courteous service to everyone with whom they have business; for operating their Booth as an office should be operated; for a willingness to extend themselves to meet any conditions that may arise.

At all times there will be one of the two operators in the Booth. Should one be crowded the one who is free should help relieve the rush. Should one do work for the other the responsibility remains with the proper representative.

Production Boards

The Production Board is made up of a number of metal pockets designed to hold 3-inch x 5-inch job tickets. The Board represents the floor, the pockets equipment and the job tickets the material or expense labor.

Each Production Booth is furnished with enough Production Boards to permit of diagraming the Departments as to the locations of the machines, benches or floor spaces performing individual operations.

The Department will be diagramed on the Board so a series of three pockets will represent each individual location arranged as a counterpart of the floor layout.

Each series of pockets will be labeled by the location number of the machine, bench or floor space it represents.

The job tickets for all material that is in the Department will be in some pocket of the board, or if conditions make it necessary the excess may be kept in the Process File.

In the first pocket of the series for any location there will always be one of the following tickets: when unit is engaged on non-productive work, brown copies of form (W-51-B); when engaged on Productive work, blue copies of form (W-27); when idle, form (W-38).

In the second pocket of the series for any location will be placed the job tickets for the next job for that machine.

In the third pocket of the series for any location, or if supervision decides, in Process File, should be placed those tickets for the lots which have been accumulated and will eventually pass through that unit.

The first pocket shows how the unit is being utilized.

The second pocket shows the next job to be worked.

The third, or remaining pocket, shows the accumulation ahead of the unit.

By using the tickets shown on the board and in Process File, an inventory of the stock in the Department as to quantity and location should be available.

When found not practical to run the Production Board in any Department as herein outlined, all work tickets will be posted on the Board by

Workman's number arranged numerically, using Process File for work tickets.

No such deviation to be made in any booth without the consent of the Planning Department Supervisor.

The Workmen's Time Card Rack

The Workmen's Time Card Rack is a series of one or more units or sections containing 25 spaces or slots for workmen's job tickets which are so arranged that the workman's name and clock number appear on a cardboard slip placed in a metal holder directly above the space or slot in which the workman's job tickets are inserted.

Workmen's Tickets

(A) *Split Lot Ticket.* If it becomes necessary to split a lot and give part undone to a workman other than the person who began the lot, a set of job tickets calling for the remainder will be made out in duplicate by the Production Board Operator. The ticket of this new set of job tickets will then be set up by the Production Board Operator as he would set up the ticket of a new lot.

(B) *Plural Job Time Tickets.* (This method to be used in extreme cases only.) It may be necessary to have an employee work on several part numbers at the same time. In cases of this kind, the employee will be given as many of these jobs as is necessary and all tickets will be treated as one should be, with the exception that the tickets will be stamped showing the number of machines operated. This should be done on the authorization of superintendent and should have the sanction of Time Study Department.

(C) *Group Work Job Tickets.* When it is practice to work two or more employees in a group, Group Credit (W-67) will be made up in duplicate at the end of each day showing date, department, group number, part number, quantity finished, piece price and total credit, one copy to Accounting Department and the other to Time Office. Group Credit Statement (W-62) is issued to Group Leader each day giving the same information.

Files

Each Booth should be equipped with sufficient 3-inch x 5-inch files to enable the Booth men to keep their tickets in neat order.

File No. 1 "Dispatched File." Job tickets for which material has been requisitioned but not yet received should be kept.

File No. 2 "Process File." When requisitions are filled job tickets for this lot will be transferred from "File 1" to "File 2" and tickets placed on Production Board as required.

File No. 3 "Secondary File." This file for work tickets on parts that are secondary in this Department.

File No. 4 "Supply File." Expense Tickets, Foreman's Order for non-productive time and any 3-inch x 5-inch forms necessary to be carried should be kept.

The Booth men are expected to handle all of their tickets through a Systematic File System. It is not neat and absolutely unnecessary to have forms scattered over the top of the desk.

Handling of Job Tickets in Booth

The Foreman when ordering stock will remove and send the requisitions and Shop Tag to the Stockroom; the remaining tickets for the lot still arranged in sequence of operation go to the Booth to be filed in the "Dispatch File" where they will remain until the stock is delivered to the floor.

When the stock is delivered to the floor the Shop Tag will be on the material; both copies of the requisition will be delivered to the Booth. The Board Operator or Floor Checker will sign both copies of the requisitions after checking receipt of material. The yellow copy of the requisition will go back with the stock man. The green copy will authorize the Production Board Operator to draw the tickets for the proper lot from his Dispatch File and place tickets for first operation on board, placing balance of tickets for the lot in file No. 2 to be drawn from until the work tickets are all completed as the material progresses through the Department. Care should be taken to see that the amount on work tickets agrees with corresponding requisitions.

The requisition is then filed according to part number and lot number for forwarding to the Division Office.

When a workman reports "off" on one job and "in" on another job, he will present the yellow copy of the job ticket for the job just finished, showing how many pieces he has completed. The Production Board Operator will take the blue copy of the job completed from the Production Board along with the tickets for the workman's next job.

The Board Operator will transfer the number of pieces reported from the yellow copy to the blue copy of the ticket for the job just completed. He will enter the workman's clock number on the copies of the new job ticket, clock and date both tickets of the new job and give the yellow copy to the workman.

The Board Operator after recording pieces will hand the blue and yel-

low copies of the completed operation, along with the blue copy of the new operation, to the Time Checker, who will enter new job on Time Card and return copy to Booth man.

Requ. Out		2584-A
Requ. Retd.		
Shippers Recd.		RECAP______________192____
Shippers Out		
Schedule		
Rejections		From Dept. No. To Dept. No.

1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					

Signed________________________

Figure 106. Recap on Requisitions Form

The Booth Operator will place the blue copy of the new job ticket in first pocket of the series representing the machine in question.

The Time Checker will clock all copies of completed job and show total time.

Recap Instructions for Booth Men

Recap on requisitions to be made out duplicate, headed "Requisitions" giving part number, quantity and lot number, one copy to be forwarded with requisitions to Production Book man daily. One copy for file.

Recap on Shippers received to be made out in duplicate, headed "Shippers Received" giving Shipper number, part number and quantity. One copy to be forwarded with Shippers to Production Book man daily. One copy for file.

Recap on shippers made out by Booth man for Sub-Assemblies completed in Department and remaining on floor, to be made in duplicate, headed "Shippers Made Out" giving Shipper number and part number. Original to be forwarded with blue copy of shipper to Production Office, duplicate to be forwarded with yellow copy of Shipper to Production Bookman daily. It is necessary to make only two copies of this shipper.

Care should be taken that all Recaps are properly headed, Department number given and signed by Booth man.

Material Checks

The Booth Operator will supervise the checking of any materials on the Production floors when requested by the Planning Department. Department Heads to furnish all necessary help to handle same. All reports to the Planning Department to be made out in a clear, concise manner giving all information requested by them.

Form W-27 Production Job Ticket

This is a 3-inch x 5-inch form furnished in duplicate, blue and yellow.

It is used to report to the Production Department and the workman a record of work done by a Productive worker on a Productive operation.

Because it saves time, as much information as possible is entered on this form before it is delivered to the Booth. However, the Booth man in handling it, O. K.'s the correctness of all information shown thereon.

The blue copy is sent from the Booth to the Accounting Department besides being used in the Booth as the material location record, it is used in the office as a check on material, piece-work prices and time tickets previously recorded.

The Production Board Operator assures the Production Department and the Time Checker that this record is authentic as to the following: clock number, part number, lot number, operation number, department number, machine and location number, pieces completed, pieces rejected, pieces credit, date.

The yellow copy is the credit report given the machine operator.

The Production Board Operator assures the workman that there is a

W-27 DATE MOVED	WILLYS WORK TICKET		EMPLOYEE NO.	
PIECES WANTED	OPERATION		PART NO.	
COMPLETED			LOT	
REJECTED	SCHEDULE NO.	OPER. NO.	DEPT.	MACH. OR BENCH
CREDIT	MOVE TO	HOURS BRT. FOR'D	S.T.	
DATE COMPLETED		LAST CARD	PIECE PRICE	
		TOTAL	TOTAL CREDIT	

Figure 107. Work Ticket Form

time ticket reporting the following: pieces credit, time consumed, part number, operation number, lot number, piece price, clock number, department number.

Deduction Slip Form W-32

This is a 3 in. x 5 in. form used to report any deduction on time tickets which have left the control of the Booth. When a check card

W-32

WILLYS
DEDUCTION TICKET

DATE______ EMPLOYE______ NO.______

THE FOLLOWING PARTS WERE NOT PASSED BY INSPECTOR BECAUSE THE OPERATION INDICATED BELOW WAS NOT PROPERLY PERFORMED BY YOU.

PART NO.______ PART NAME______ DEPT.______

LOT NO.______ SCHED. NO.______ OPER. NO.______ S. T. OR P. P.______ NO. PCS.______

DEDUCT______STD. HRS. OR $______ FROM THE AMOUNT CREDITED TO ME ON THIS OPERATION.

REMARKS: SIGNED BY EMPLOYE______

APPROVED______ FOREMAN______

Figure 108. Deduction Ticket Form

clerk or Booth Operator discovers an error on a time ticket, he will make the correction on a Deduction slip in triplicate. He will hand all copies to the Department Time Checker where the error was made. After being properly signed by foreman, workman and Time Checker they will be distributed as follows:

1 to Accounting Department
1 to Time Office
1 to Workman

This form is also issued in triplicate by Inspector for Deductions caused by defective work. He will hand them to Time Checker who will have copies properly signed and distributed.

Allowance Slip Form 32-B

This is a 3 in. x 5 in. form furnished in triplicate, two white and one pink. These are accomplished by Time Checker in triplicate in case piece-

W. O. Form 32-B

CASH ALLOWANCE

Employee's Name					Clock No.		Dept. No.		
Part Name							Part No.		
Operation Name					Operation No.		Lot No.		
Hours Worked				Day Rate			Amount		
No. Pcs. Finished				Piece Price			Amount		
				Amount of Cash Allowance					
Reason									
							Acct. No.		
Issued by					Date				
Appvd.					Appvd.				
				Foreman			Time Study Rept.		

Original Fastened to Daily Time Card – Duplicate to Employee – Triplicate to Time Study

Figure 109. Cash Allowance Ticket Form

worker does not make his day rate. After being properly approved by foreman and Time Study Department, they are distributed as follows: original attached to Time Card; duplicate to workman; triplicate to Time Study.

Form W-37
Foreman's Order for Non-Productive Work Ticket for Productive Worker

This is a 3 in. x 5 in. form furnished in single sheets of 100 sheet pads. It is used and signed by foreman to authorize the Board Operator to issue to a productive workman a work ticket on any work which is not shown on a routing sheet, and is presented by workman to Booth Operator. Foreman will enter on form estimated time to be allowed on the non-productive operation.

W-37

WILLYS

FOREMAN'S ORDER FOR NON-PRODUCTIVE WORK TICKET TO PRODUCTIVE WORKER

MAN. NO. ______ MACH. / BENCH NO. ______ DEPT. ______

REASON FOR NON-PRODUCTIVE

______

______

DATE ______ ______ FOREMAN

TIME ISSUED ______ TIME TO BE COMPLETED ______

Figure 110. Foreman's Order for Non-Productive Work Ticket to Productive Worker

When a condition arises where the Board Operator has no regular productive operation lined by for a workman or where something occurs that requires the workman to go on expense or to do a production operation differently than outlined on routing, this form should be issued, as otherwise the Board Operator has not the authority to "write-up" the workman.

Should a workman still be on an expense ticket at the expiration of the time limit, the Board Operator will inquire of the foreman whether an extension should be made or whether the workman should be given a regular production ticket.

Form W-63
Group Transfer

This is a 3 in. x 5 in. form furnished in single copy, yellow.

It is used authorizing the transfer of men from one Group to another where Group System is installed. Made out by foreman and delivered to Booth Operator who will clock same and hand to Time Checker for recording.

Form W-63

GROUP TRANSFER

DATE________________ EMPLOYEE NO.________

TRANSFER FROM GROUP__________ TO GROUP__________

TRANSFER FROM OTHER WORK____________________

TIME EFFECTIVE__________ A. M.__________ P. M.

REMARKS______________________________

SIGNED____________________
FOREMAN

Figure 111. Group Transfer Ticket

Form W-62
Group Credit Statement

This is a 3 in. x 5 in. form furnished in single copy, white.

It is used as a Credit Statement to Group Leader where Group System is in force, showing Total Credit for the Group's work that day.

Form W-67
Group Credits

This is an 8½ in. x 11 in. form furnished in single copy, white.

It is used as a Group Credit by the Accounting and Time Departments and is made up daily where Group System is in force.

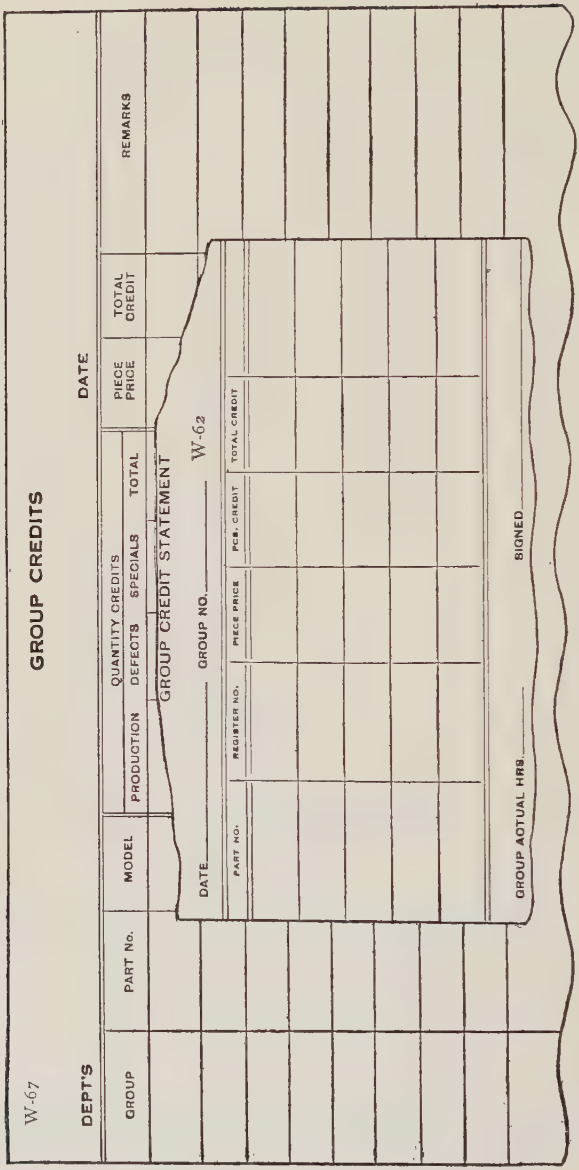


Figure 112. Group Credit Statement Form
Figure 113. Group Credits Form

Form 51-B
Non-Productive Work Ticket

This is a 3 in. x 5 in. form furnished in duplicate, buff and yellow. Buff is the Production Department's copy, yellow is the workman's copy. These two copies should go through the same channels the regular productive job tickets go through.

This form has been designed to report labor expenditures on any expense operations. The color scheme advises any person who handles this ticket that the time and money are to be handled as an expense.

W-51-B DATE MOVED	WILLYS NON-PRODUCTIVE WORK TICKET		EMPLOYEE NO.	
PIECES WANTED	DESCRIPTION OF WORK		ORDER AND ACCT. NO.	
COMPLETED			PART NO.	
REJECTED	SCHEDULE NO.	OPER. NO.	DEPT.	MACH. OR BENCH
CREDIT	MOVE TO	HOURS BRT. FOR'D	S. T.	
DATE COMPLETED		LAST CARD	PIECE PRICE	
		TOTAL	TOTAL CREDIT	

Figure 114. Non-Productive Work Ticket

The most common usage of this form is in the reporting of time for the following: straight expense workers, truckers, stock handlers, stock checkers, sweepers, millwrights, oil men, repair men, inspectors, etc.

Productive workmen when employed on expense work, repairing equipment, repairing material, oiling machinery, work or a productive piece which is not routed, and on which the work has to be handled as an expense, setting dies, or tools, etc.

This ticket should be issued by the Board Operator to workmen, only on the authority of the foreman. In case of a straight expense workman, the advice of the workman's employment is sufficient authority to issue this time ticket. In case of a productive workman the authority of the foreman must be given on form W-37, "Foreman's order for non-productive work ticket."

The production and workman's copy are handled while in force in the Booth exactly similar to form W-27.

Form W-28A
Move Order

This is a 3 in. x 5 in. form furnished in single copy, yellow.

It is used as authorizing movement of material from one point to another, most generally from one Productive Department to another Productive Department.

Wherever possible, this will be furnished arranged in proper sequence after the job tickets for the last operation in any Department by the dispatcher.

<table>
<tr><td colspan="6">W-28-A
WILLYS
MOVE ORDER</td></tr>
<tr><td colspan="2">PART NO.</td><td colspan="2">QUANTITY</td><td colspan="2">LOT NO.</td></tr>
<tr><td colspan="3">MOVE FROM</td><td colspan="3">DELIVER TO</td></tr>
<tr><td colspan="2">DEPT.</td><td>MACH.
BENCH</td><td colspan="2">DEPT.</td><td>MACH.
BENCH</td></tr>
<tr><td colspan="3">DEPT.</td><td colspan="3">DEPT.</td></tr>
<tr><td colspan="6">REMARKS</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td>DATE</td><td colspan="2">SIGNED</td><td colspan="3">REC'D</td></tr>
<tr><td colspan="6"></td></tr>
</table>

Figure 115. Move Order

After the last operation in any Department is completed, this move order is automatically released and is used by the Board Operator to authorize the stock mover to take the lot indicated to the Inspection Department. For movement of parts to another Division see Division Shipper Form 2546-A.

The Board Operator on receipt of Division Shipper 2546-A in the new Department will draw the tickets for the lot indicated and place them in the proper pocket on his board.

Form W-30
Storeroom Receipts

This is a 3 in. x 5 in. form furnished in triplicate, pink, brown and yellow.

This form has been designed to report material that has been finished and is held on floor for assembly, the quantity rejected, the quantity passed as good, this is authority for Booth men to make Divisional Shipper showing that these parts are finished and held on the floor for assembly.

W-30

WILLYS
STORE ROOM RECEIPT
FINISHED PARTS

PART NUMBER		LOT NO.
PART NAME		
QUANTITY INSPECTED	QUANTITY REJECTED	QUANTITY GOOD

FROM DEPT.	TO STORES NO.	DATE
		INSPECTED BY

Figure 116. Storeroom Receipt—Finished Parts

In Dept. 45-45A-28

Pink copy is forwarded with recap to Production Office.

Yellow copy is forwarded with recap to Division Office.

White copy is retained for file.

No shipper being made in these Departments for material held on floor for Assembly.

Division Shipper form 2546-A

Issued in quadruplicate when material is being transferred from one Division to another, white copy and pink copy forwarded with material. Yellow copy to Production Book. Blue copy for Production Office. White copy in most cases is used by Traffic Department as workman's ticket showing delivery where piece prices are in effect.

Stock Requisitions

This is a 3 in. x 5 in. form furnished in duplicate. Green, production copy; yellow, stock copy.

2546-A WILLYS DIVISIONAL SHIPPER Series B № 95782

Form Dept. No.______ To Dept. No.______ Date______

ORDER NO.	PART NO.	NAME OF PART	QUANTITY

Shipped by ______

Received by ______

Trucked by ______

THIS COPY GOES TO THE SHIPPER

No. Pieces		COST	EXTENSION	Account Dr.	Account Cr.
	Material				
	Labor				
	Burden				
	Total				

Figure 117. Divisional Shipper Form

Rough Stock Requisition W-52
Partly Finished Stock Requisition W-60
Assembly Requisition W-58

This form authorizes the Stock Department to deliver material to the floor. It is sorted in front of the set of job tickets, and it remains with the job tickets in the Division Office until the foreman orders material from stock to the floor.

When material is ordered both copies of the requisition, along with Shop Tag, W-29, are delivered to the Stockroom, the remaining job tickets still intact are placed in the dispatched file in Booth.

When material is delivered, the Stock man presents both copies of requisitions to the Board Operator, the Board Operator assures himself of the Stock Delivery, signs both copies of the requisitions, gives the yellow copy to the Stock man and keeps the green copy.

The Board Operator uses the green copy to release the job tickets for the lot the requisition calls for, he draws the job tickets intact from his dispatched file and places tickets in his Process File.

The requisition is then filed to be sent into the Division Office where it is used by the Book man in posting his Production Book.

This is a very important form.

W-52 ROUGH STOCK REQUISITION – PRODUCTIVE			
QUANTITY TO MAKE	PART NO. TO MAKE		LOT NO.
PART NAME			
MATERIAL USED			
			QTY. DISBURSED UNIT
			UNIT PRICE
			AMOUNT
FROM STORES NO.	DELIVER TO DEPT.	MACH.	ACCOUNT CLASSIFICATION
	ORDERED BY	DATE	
	B Copy To Stockroom - To Booth Clerk - To Prod. Control		

Figure 118. Rough Stock Requisition

W-60 WILLYS STOCK REQUISITION PARTLY FINISHED PARTS		
QUANTITY	TO MAKE PART NO.	LOT NO.
TO MAKE PART NAME		
REMARKS		
FROM STORE NO.	DELIVER TO	DATE ________
	DEPT. ______ MACH. ______	SIGNED ________
Booth to Stockroom - Stock to Booth · Booth to Cent. Prod. Office		

Figure 119. Partly Finished Parts Stock Requisition

W-58

WILLYS
ASSEMBLY REQUISITION

ORDER FOR ________ SETS	TO MAKE SYMBOL NO.	LOT NO.
DESCRIPTION		
FROM STORE NO.	DELIVER TO DEPT.________ BENCH________	DATE________ SIGNED________

C Copy – To Stockroom – File

Figure 120. Assembly Requisition

265 Miscellaneous Material Requisition and Move Order No.________

Furnish to ☐ Stores ☐ Dept. No.________ from ☐ Stores ☐ Dept. No.________ Date________

The following ☐ Productive ☐ Non-Productive material for ☐ Production ☐ Expense ☐ Mail Order to make Part No.

Charge ☐ Stores ☐ Dept. No.________ Acct. No.________ Work Order No.________ CREDIT ACCT. NO.

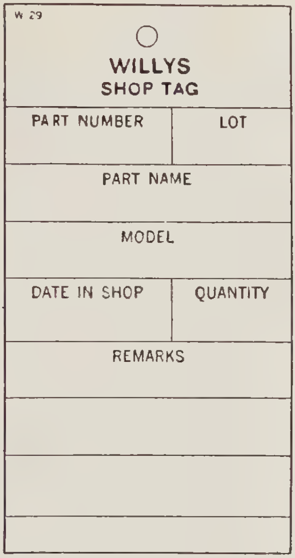
Quantity Required	Part No.	Description	Quantity Delivered	Unit Price	Amount	Stores	Expense

Cost Summary	Unit Price	Amount	
Material			Ordered by________
Labor			
Burden			Approved by________
Total			

Figure 121. Miscellaneous Material Requisition and Move Order

Shop Tag W-29

This is a 3 in. x 5 in. form furnished single in strawboard. It is an identification tag and should remain with the material it represents from the time the material leaves primary stock until it reaches finish stock.


W 29

WILLYS
SHOP TAG

PART NUMBER	LOT
PART NAME	
MODEL	
DATE IN SHOP	QUANTITY
REMARKS	

Figure 122. Shop Tag or Identification Tag

It should be furnished by the Dispatcher along with each set of job tickets and should be delivered to stock along with requisitions.

Form 33-B
Shortage Notice

This is a 3 in. x 5 in. form furnished in triplicate.

It is used by the Stock Department to notify the Booth that material called for on a requisition cannot be filled. One copy retained with requisition by Stock man until material is received. Two copies sent to Booth Operator, who forwards one copy to Book man and retains one copy.

This should be filed in the dispatch file, attached in front of the job tickets representing the lot in question.

33-B

WILLYS SHORTAGE NOTICE

DEP'T ______ STATION ______ 19 ____

STOCKROOM ______ IS SHORT OF STOCK

PART NO. ______ ASSEM. NO. ______

PART NAME ______

LOT NO	QUAN. REQ'D	QUAN. DEL'D	TOTAL DEL'D	QUAN. DUE

SIGNED ______

Figure 123. Shortage Notice

Form 2520
Routing Sheet

This is a form 8½ in. x 11 in. furnished in single copy, white. This is issued by the Time Study Department authorizing the payment of certain prices for each operation in the Department and will be given careful attention by the Booth Operator.

Signed....................
Planning Department

Date: ....

Approved ....
Production Department

Signed....................
Factory Accounting Department

Thursday

CHAPTER XXIX

TIME STUDY

Purpose of Time Study.—Time study work is not necessary for planning, neither is it necessary for any of the phases of planning such as routing, scheduling, and dispatching, but if time study is not employed, large arbitrary allowances must be made with the inevitable result that the scheduling and control are loose and anything but economical. Also, in most industrial concerns work of various kinds is now to a greater or less extent on a piece-work or some other form of incentive basis. Operations, or to use the layman's terms, work whether it is office work or work in the shop can be put on an incentive basis without making time studies, but experience has proved that almost invariably the rates thus set are either ridiculously loose or else so impossibly tight that they are unjust to the worker. In the first case, production is held down for fear of rate cutting and in the latter case, bad feeling exists between employer and employees. For these and other reasons, as will be mentioned later, time study is now common practice in the majority of industrial concerns. Although in many concerns time study is introduced primarily for the purpose of setting rates for piece-work or some other form of incentive wage, its true purpose is threefold: (1) to determine the one best way of doing a task and the proper elapsed time for doing the task in the one best way; (2) to secure better and more accurate control in planning; (3) to serve as a basis for the setting of fair and adequate wage rates.

Meaning of Time Study.—The layman usually thinks of time study as merely using a stop watch in timing a person doing a task and then setting the rate accordingly. This is all wrong. Taking the time with a stop watch is only one part and in fact one of the simplest phases of time study work. When time study is referred to it implies job standardization, hence all elements entering into the doing of a task must be considered and studied with a view to improvement and standardization. The factors or elements entering into production are the time of doing the task, the materials used in making the product,

the quality required, the equipment used in performing the task and the workman or person doing it. In the performance of some tasks the element of time may be the most important, while in others economy in the use of material or strict adherence to a set standard of quality may be all-important. The standards which are set through time study, therefore, are not simply standards of time but are composite standards. They are standards of methods and of all elements entering into production and are so set as to reflect the relative weight or importance of the elements. On a certain operation it may be possible for the skilled operator to turn out 25 pieces per hour if the cost of material is not an important factor; as the material used, however, is quite expensive the standard may be set at but 22 pieces per hour so as to hold down and practically eliminate waste due to scrap. Standards do not represent perfection. They are the highest practical attainment under existing conditions. If later conditions change or improvements are found, the task would be subject to re-analysis and new standards set accordingly.

Material as a Factor in Time Study.—It may be that the article or part under consideration is made of expensive material, of high grade leather, expensive fabric, platinum, or so on. In such cases the time study man should make special note of the fact and give it due consideration when making the study and setting the standards. Also, it must be borne in mind that each time an operation is performed on a part, direct labor and overhead expense are added to its cost, therefore, the value of a "part" may increase greatly as the part approaches completion in the sequence of operations performed on it. This, too, must be considered when making the study and setting the standards. The standards of production set and the incentive given to attain these standards should directly reflect and give due weight to the value of the material in the article under consideration so as to eliminate avoidable waste of material, all factors being considered.

Quality as a Factor in Time Study.—When time study work is started for the first time in a plant, almost invariably the same thing happens. Everyone—foremen, workers, inspectors and all—begins to stress "quality." This may be done as a camouflage to cover up inefficiency and thus try to account for the low production which has been turned out in the past, or it may be due to fear that rates will be set without due regard for the quality required or some other reason.

Before any attempt is made to increase quantity, the quality required should be definitely determined. If the quality does not happen to be definitely given on the blueprint or otherwise, then someone in sufficiently high managerial authority should specify in writing or in some other definite way the standard of quality required so that later there can be no doubt when the question of quality arises. It is best always to keep out of arguments, therefore avoid asking an operator such questions as "What is the tolerance on this operation?", "What finish is required?", and so on. All such information should be secured in detail by the time study man from the blueprint of the part or from some other authoritative source, before he goes to the shop to make the study. In setting the production standards and assigning a wage incentive, both should reflect the relative importance of the quality required.

Equipment as a Factor in Time Study.—In order to make the explanation more definite, the discussion in the remainder of this chapter will be confined to time study work in a machine shop. However, the general methods and principles brought out are applicable in any kind of work.

From the operation or route sheet, the time study man should find out what equipment is to be used in performing the operation or task. Notation should be made on the time study sheet as to the workplace or kind and size of machine on which the operation is to be done, exactly what jig or fixture, if any, should be used, what gages and cutting tools are needed, the number of pieces made or worked on at one time, the number of machines one man operates at a time or, if the operation is done by a group of men, how many persons there should be in the group and the status of each person in the group, also whether the operator does only the one operation or should he do two or more operations at the same time. If on the operation sheet the feed and speed at which the machine should run are given, such and similar information should also be noted on the time study form. All of these data should be noted on the time study sheet while the time study man is in his office and before he goes to the shop to make the study there. At this point it is also well to make note on the time study sheet as to the present production schedule on the part or task to be studied, as well as the possible production in the near future. This information is necessary as it has a direct bearing on recommen-

dations which the time study man may later make in regard to the tools, jigs, or fixtures, the machines used and the method of operation.

Operator or Worker as a Factor in Time Study.—In a preceding chapter it was brought out that some persons are more suited for certain kinds of work than others. Time study work includes the recommending for transfer to other work of workers who are unsuited for the work to which they have been assigned. Such conditions, if they exist, will be revealed when those operations are studied. It is a common occurrence in manufacturing to have two or more persons doing the identical operation at the same time. As a rule in such a case it is not necessary to make a study on each operator,—a study on one operator, if properly made, will serve for all operators on that job. However, on the time study sheet should be listed the names or preferably the employment clock number of each operator working on the task. It must be remembered that in repetitive work after an operator has performed a task numerous times under proper guidance he becomes a skilled operator at that task. It is evident, then, that in so far as possible all time studies should be made on average skilled operators. The question then arises "What is meant by a skilled operator?" A skilled operator may be considered as one who is fitted for his work, is reasonably handy, is experienced in doing the task and is conscientious in what he does. It is the average skilled operator that should be studied, not the exceptional one. If a superskilled operator is studied, when setting the standards it may be necessary to scale down the results and make allowances accordingly. If studies are made on unskilled operators the adjustments necessary would be just the reverse. It requires considerably more skill on the part of the time study man to take studies on unskilled operators.

It is of the utmost importance that the time study man win and retain the goodwill, complete confidence and cooperation of the workers, the foremen and the superintendent. Therefore, in all his dealings with them the time study man must be absolutely honest, square and aboveboard in every respect. It is necessary not only to point out but to convince the superintendent and the foremen of the various ways in which time study work and production control in general will be of service and of value to them. It is necessary to enlist their enthusiasm and aid in making suggestions and in other ways assist

in the working out and installing of the production control system and the accompanying time study work. Much of the success in time study work and in developing an adequate, smooth running and economical production control system is due to suggestions given by the superintendent and particularly by the foremen, on account of their experience and intimate knowledge of local operating conditions.

The Time Study Man and the Operating Force.—There is nothing mysterious about time study work nor anything that should be kept secret. Even in concerns where it may not be advisable or desirable to install piece-work or other incentive systems, time study work may be employed to great advantage in detecting operating inefficiencies, in the development of new and better tools, jigs and fixtures, in determining the best arrangement of machines and the best method of handling materials, in determining whether it would be more economical to split an operation into two separate ones or possibly to combine two or more operations into one, in balancing the shop equipment and production and in finding out how fatigue on the part of the worker may be reduced to the greatest extent and how a task may be performed in the most economical way. These are merely some of the other things for which time study may be used, in addition to setting adequate and fair wages. All of these things should be pointed out and carefully and fully explained to the superintendent and foremen as well as to such of the workers as it may be deemed advisable. The foremen and the operators may be shown in detail how the stop watch works and how the complete time study is taken, how the allowances for fatigue, personal needs, grinding tools, set-up time, etc., are determined, how the standard time and rate of production are computed, and so on. When the foremen and the workers fully understand these things they become intensely interested and, if properly guided, they will wholeheartedly cooperate in the work. This is where the personality and tact of the time study man play an important rôle.

The time study man should refrain from criticizing an operator's work or the methods he uses. His suggestions should always be constructive and given only to the extent of the worker's receptiveness to them. Most of the improvements probably will come through the foreman. It may be best not to ask an operator what amount of work he turns out per day, neither should he be asked his wage rate

nor the amount of money he makes in doing a task. The time study man should have this information and it should be entered on the time study sheet at the time the study is made. Invariably, sooner or later the management will want to know how much money is being saved through time study work, therefore it is necessary among other things to have an accurate statement of the quantity produced per hour and the direct labor cost on each operation or task, both before and after time study has been employed. In entering this information on the time study sheet it is best to secure the data regarding past production and costs from the company's own records and not from the guesses of the operator or the foreman. If possible, the information regarding production and cost should be the average over a reasonable period of time because both production and costs vary from time to time and neither the peak nor the valley of such variations is wanted. For obvious reasons it may be desirable, too, that all such data be collected and given to the time study man by the cost accounting section or whatever section is responsible for compiling that information and should not be compiled directly by the time study section.

Equipment Required for Taking the Times.—In addition to time study forms [1] and a good medium hard pencil that will not smear, there will be required a slide rule, a speed indicator, a time study observation board and a stop watch. The speed indicator is needed only when a study is made of a machine operation or when it is desired to know the R.P.M. of a spindle or shaft or to measure surface speed.[2]

The time study observation board is used as a portable writing stand, when taking the time on all studies. It is a smooth ⅜ in. board about 10 x 14 in. in size. At the top of the board is a stout steel clip under which time study forms can be held firmly. The upper right corner of the board for about 3 inches in from the right side is made a trifle longer than the body of the board in a semi-elliptical shape with short axis vertical. On this corner of the board and partly on the extension is mounted a special three-point steel

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[1] An illustration of a time study form is shown in Figure 125. On the reverse side of the sheet a space is provided for entering certain data which are different from or in addition to that called for on the front side of the sheet. A space is also provided in which the time study man may draw a sketch of the part being worked on or a portion of it, showing by means of heavy lines the cut which is made. On the sketch would also be shown the limits and all other necessary details.

[2] Surface speed may be of either translation or rotation.

spring clip in which the stop watch can be inserted and held. When taking the time on a study the bottom edge of the board is allowed to press against the observer's body, the upper edge of the board resting on the left forearm and the left hand holding the board by gripping the extension used for holding the watch. The watch, then, can be easily manipulated with the left hand while recording time and making notes on the time study form with the right hand.

(Courtesy of A. R. & J. E. Meylan)
Figure 124. A Minute Decimal Timer
(Stop Watch)

There are two types of stop watches generally used in time study work, both read in decimals, one in hundredths of a minute, the other in decimals of an hour. A split second watch, that is, one reading in seconds and fractions of a second, is not suited for time study work. A minute-decimal timer is shown in Figure 124.

Referring to the watch shown in Figure 124, one complete revolution of the long hand consumes exactly one minute and readings may be made accurately in hundredths of a minute. In fact, there are three forward movements of the hand for each one-hundredth of a minute, therefore, it is possible to make readings accurately to one three-hundredths of a minute, but in practice, readings are recorded

only to the nearest hundredth. In reality, as shown in Figure 124, there are two hundredth hands moving together, one of which may be stopped and started at will while the other continues to revolve. The small hand at the top of the dial records in minutes only, while the small hand at the bottom of the dial records in seconds only, but this latter reading is rarely used. By slightly pressing down on the winding stem, the escapement of the hundredth hands and the minute hand are released and the hundredth hands begin to revolve. A slight pressure on the attachment just to the left of the winding stem instantly stops one of the long hundredth hands while the other continues to revolve. When the time indicated by the hand which has been stopped has been recorded, a second press on the side attachment at the left of the stem causes the hand which had been stopped to snap forward and again travel with the other long hundredth hand until it is desired to stop it again by pressing the side attachment. This may be repeated as often as desired, thus permitting continuous readings for as long a duration of time as desired. Each time the hundredth hand makes one complete revolution, the small minute hand at the top of the dial snaps forward and records the minutes accordingly. By pressing the winding stem a second time both hundredth hands and the small minute hand at the top of the dial are stopped. A third push on the winding stem throws all hands back to zero ready to start over again. The second hand at the bottom of the dial runs continuously and cannot be stopped or started at will. All time studies illustrated in the chapter were taken with this type of stop watch.

The hour-decimal timer is similar to the minute-decimal timer except that its readings are in decimals of an hour instead of decimals of a minute. The readings may be recorded accurately to four decimal places time in hours. Many time study men prefer the hour-decimal timer to the minute-decimal timer.

Stop watches are rather delicate time pieces and are subject to hard usage, hence are likely to require frequent regulating. At least once a day, preferably the first thing each morning, the time study man should check his watch with a good ordinary watch. This checking should extend over a period of at least a half-hour and if the stop watch runs more than 1% either too fast or too slow it should not be used for time study work until properly regulated.

Operation and Element Defined.—At this point it might be well to define what is meant by an operation and an element. "The term 'operation' is used to describe any course or series of acts performed either by one workman or by a group of workmen as a unit which either adds one step to the complete process or constitutes in itself a complete process; while the term 'element' refers to any division or subdivision of an operation which corresponds to an individual motion and which has definite points of starting and stopping." [3]

There is no standard rule governing what constitutes an element. An element may be composed of only a very few motions, yet again it may include many depending upon numerous things, such as the duration and nature of the operation, if it is a machine operation the per cent of machine time to that of handling time, and so on. However, in every case there must be a definite starting point and a definite stopping point for each and every element. For example: "pick up piece from tote pan on stand at left," or "throw in power feed" or "hand to tail stock." In each case the element is clean-cut and each time it occurs in the doing of an operation there can be no question as to exactly the instant at which the timing of that element should begin and end. In this way not only the operation as a whole but each element in the operation may be studied with the object of improving the way of doing it and then standardizing on the one best way.

Two other points must be kept in mind. First, too many motions should not be included in any one element. If too many motions are included in the course of performing a repetitive operation, it would be difficult, if not impossible, to account for variations which may occur in the time taken to do the respective elements during each complete cycle of the operation. It is better to err by dividing an operation into too many elements. After the study has been taken it is always possible, if desired, to combine two or more consecutive elements on the time study form, but it is not possible to divide an element without timing the task all over again. The second point to continually keep in mind when breaking an operation down into its elements is that the same element may reoccur two or more times during the cycle of the same operation, and also that in performing different tasks frequently the identical element will occur in several. This is especially the case when different operations are performed on the

[3] W. O. Litchner, Time Study and Job Analysis, The Ronald Press Company, p. 155.

same machine or on similar types of machines. Therefore, in deciding what motions to include in an element, this point of interchangeability of elements and the time to perform them in different time studies must be carefully considered, and the elements standardized accordingly. The element "raise spindle, replace drill with reamer, lower spindle" occurs in many drilling operations. When it occurs in an operation which is performed on a sensitive drill press, 0.04 minute may be the standard time for doing it, while 0.08 minute may be allowed for that same element when an operation is performed on a Silver drill press, 0.10 minute when done on a Barnes drill press and 0.11 minute when on a #310 Baker drill press. For common jobs when it is necessary to gage only one out of every ten pieces, a standard allowance of 0.01 minute per piece may be given for gaging drilled holes in small parts with a plug gage. On close jobs when it is necessary to gage one out of every five pieces, 0.03 minute per piece may be the standard allowance for gaging the diameter of a part with a snap gage. Whenever a standard element occurs in any operation or task, such should be indicated and the corresponding standard time assigned to it on the time study sheet.

Analyzing an Operation into its Elements.—An illustration of analyzing an operation into its elements is shown in Figure 125. Note how clear and complete the name of the operation is given: "Drill one $\frac{35}{64}''$ hole, $1\frac{3}{4}''$ through and ream to 0.562″ diameter." Care must be taken to state the operation accurately. The hole is not drilled $1\frac{3}{4}''$ deep but it is drilled through the part. It would make a difference in the standards set if the hole did not go through, even though the depth of the hole was the same as if it went through. Unless a standard commercial size is desired, the specified limits are also given. All this wording must be accurate and complete so that if later any change in the operation is made it will be seen immediately that the study was taken under different conditions, hence may be subject to re-analysis and new standards set for it. Note the starting and stopping points of each element. Note also that the elements are so worded that the motions cannot be misinterpreted. By carefully reading them a visual picture is obtained of the exact manner in which the operation was performed. Also note that the second, fourth and sixth elements are "standard" elements which occur in many drilling jobs. In whatever job these elements occur, if the operation is per-

OBSERVATION SHEET

Date April 10, 1927

Part Name Brake Support Spring Bracket (left) — Material #3 HRS Forging — Part No. 305166
Oper. Name Drill one 35/64" hole, 1 3/4" thru & ream to .562" diam.* — No. 30 — Dept. 50
Man's No. 26230 — Qual. Good-Skilled — Model 4-all types — No. Per Car 1
Mach. Barnes Drill Press — No. 2855 — Feed .009 — Speed 364 R P M - 54 cut ft
Mach. Floor Space 15 sq ft — Length 5 feet — Width 3 feet — Is Floor Obstructed No

Detail Movements	I	II	III	IV	V	VI	VII	VIII	IX	X	Min. Time	Avg. Time	Standard Time
			Individual Times Upper Blocks / Cumulative Times Lower Blocks										
① Pick up piece from pan on stand at left Place in fixture and clamp	.06	07	08	06	07	11	.07	06	.08	07	06	.073	07
	.06	110	220	324	432	541	649	756	875	977			
② Lower spindle & throw in power feed	.04	.05	05	.05	06	07	04	.05	04	05	04	05	05
	10	1.15	225	329	4.38	548	6.53	761	8.79	982			
③ Drill one 35/64" hole 1 3/4" thru (Power feed)	.65	.69	.66	.68	.65	64	.68	68	.65	.66	.64	.664	66
	75	1.84	291	3.97	503	6.12	721	8.29	944	10.48			
④ Raise spindle, replace drill with reamer Lower spindle	10	10	.08	09	10	10	10	11	10	.09	08	.097	10
	85	1.94	2.99	4.06	513	622	731	8.40	9.54	10.57			
⑤* Ream to .562" diam 1 3/4" thru (Hand feed)	08	.07	08	08	05	06	06	11	.06	08	.05	.068	07
	93	2.01	307	414	5.18	628	737	8.51	960	1065			
⑥ Raise spindle replace reamer with drill	05	05	.04	.05	.06	.05	05	.06	.05	.05	04	051	05
	.98	206	3.11	4.19	524	6.33	7.42	857	965	10.70			
⑦ ** Remove piece from fixture & put in pan at left on stand	.05	06	07	06	06	.09	.08	10	05	.05	05	.067	.06
	1.03	212	318	425	5.30	642	750	8.67	9.70	10.75			
Totals	1.03	1.09	1.06	107	105	112	108	117	1.03	105	96	1075	106

Time Lost and Reason		
	Allowed Lost Time Per Hour / Set Up Time — 10% - 6 min	11
5% personal allowance & fatigue (26 min/day)	Allowed Time Per Piece	117
5% tool time & handling stock (26 min/day)	Piece Work Price B.R 66¢/hr.	$130/c
	Quantity Per Hour	51
	Quantity Per Shift of Hours 8 6 hrs	442
Gage last piece while doing element ③	Man's Rate Per Hour D W	50¢
* Commercial size	Present Quantity Per Hour D W	35
** Two tote pans used - one each for rough & finished parts	Present Labor Cost Per Piece D W	$143/c

Agree Machine is set at Most Efficient Speed and Feed and Production is O K. J Brady
Finished Part Goes to Dept. No. 90 Bldg - Model 4 Rear system unit assembled
Bruce Johnson Observer

Figure 125. A Time Study. An illustration of analyzing an operation into its elements

formed on a Barnes drill press as in this study, the same standard time should be assigned to the respective elements as are given on the study here illustrated.

Responsibility for Production.—Two of the ultimate purposes of time study work are to increase production and lower costs. It must be remembered that the foreman of the shop is responsible for production, hence he is responsible for seeing that all jobs or operations in his section are being performed, all factors considered, at the highest degree of efficiency. However, unless precaution is taken the foreman will shift the responsibility of "bringing up" the operations to where they should be before they are timed to the time study man. Of course, it is the duty of the time study man to increase efficiency and lower costs or to make recommendations which will bring about this result wherever he finds conditions which are not what they should be. Nevertheless, it is desirable to take full advantage of the experience, knowledge and skill of the foreman and to conserve his time and the time of the time study men as much as possible. In order to insure that the foreman does his duty in regard to "bringing up" the jobs and does not shift that work to the time study men, he may be required to fill out and send to the time study section a "request for time study" form which, when signed by the foreman, implies that the operation is now running to the best of the foreman's ability. This method causes the foreman to be on the alert and to exercise considerable thought and care in "bringing up" each operation in his shop to where it should be before requesting that a time study be made.

In making a time study on an operation it must also be remembered that the operations following as well as those preceding the operation in question have a bearing on it. Therefore, in time study work it is desirable, if possible, to begin with operation number one and then continue making the studies in the numerical sequence as operations occur as listed on the route sheet. A great many times, however, due to various reasons, this cannot be done and it is necessary to take the time study when and where the opportunity presents itself.

Preparatory Step Before Taking the Time.—It is assumed that the foreman of the shop has sent to the time study section a request for a time study on a certain operation in his shop. The time

study man, after ascertaining that the operation has never before been timed, fills out a time study form with all information relating to the operation that he can secure in the office, such as data taken from the route sheet, blueprint, production schedule, time studies already taken on similar operations and parts and other sources. He then goes to the shop, locates the job, and if other persons are doing the same operation he makes note on the time study form of their clock numbers as well as the number of the machines on which they are working. He then studies the operation until he is familiar with every detail, including all limiting factors. Even though the foreman is supposed to have brought up the job to proper operating efficiency, the time study man usually will have suggestions to make in regard to the method of handling the stock, or of performing some part of the operation, in regard to the feed or speed, tools, jig or fixture or something else. These suggestions he may pass on to the foreman who will see that they are tried out, or according to local conditions, he may deal direct with the operator. When the operation is being performed exactly as the time study man wants it to be done he proceeds to take the time. However, if some change is to be made which would necessitate several days' or possibly weeks' delay, it probably would be advisable to get the operation running in the best possible manner and set temporary standards which would become void when the change is made or possibly on some definite date. It may be that conditions existing at the time would not warrant the making of the changes or improvements in question, in which case note to that effect should be made on the time study form and also in a notebook kept for that purpose, so that the matter will not be lost sight of and may be taken up at the proper time in the future.

Where to Stand When Taking the Times.—The place where the time study man stands while making the observation and taking the times with his stop watch is important. It is best not to stand directly in front of the worker as that makes him more or less nervous and, besides, in such a position the observer probably would be unable to see all that goes on. It is necessary that he stand in such a position that he can observe not only every motion made by the worker but also see clearly at all times exactly what the machine is doing. Naturally, he should be careful not to obstruct the light from

the worker. The usual practice is to stand about three or four feet back of the worker and slightly to the right or possibly the left, according to conditions.

A Precautionary Step.—It is assumed, of course, that the job has been "brought up" to proper operating efficiency and is being performed to the satisfaction of both the foreman and the time study man, and that the time study man has made all entries called for on the time study form which are possible up to this stage of the study. In order to facilitate matters it may be desirable for the first few studies to have the foreman present when the time study man takes the times with the stop watch. This will enable the foreman to become more familiar with time study work and later enable him to readily approve the study after the standards have been computed. After the foreman has personally seen several studies taken and computed he will then have full confidence in the method and in the time study man's ability. Therefore his presence at the time the study is taken may no longer be necessary.

Methods of Taking the Times.—There are several methods used in taking the times with a stop watch. Each has its place in time study work. As to which method should be employed depends upon the purpose for which the timing is to be done. Owing to the limited space allowed to the subject of time study work in the text, only the more common methods will be discussed.

Continuous and Non-Continuous Times.—The difference between continuous and non-continuous methods of timing is that in the latter case the time consumed in doing only one element, series of elements or one complete cycle of the operation or task is taken. This timing, however, may be repeated numerous times so as to get an average, or as a check, but the stop watch is stopped and the hands snapped back to zero between the taking of each time. With the continuous method the watch is permitted to run continuously during the taking of the time of numerous consecutive complete cycles of the operation. When the non-continuous method is used care must be taken, otherwise a certain amount of unavoidable lost time which occurs between consecutive elements and cycles of an operation may be omitted, with the result that the standard time set is likely to be too tight.

Overall Time Method.—This method is the timing of a complete cycle of a task without breaking down the operation into its elements, or possibly an attempt may have been made to break down the operation into elements, but too many motions have been included in an element or, in other words, several consecutive true elements have been combined to form a so-called element. In either case, it is not possible to analytically study the resultant time recorded so as to definitely locate inefficiencies, improve the details of performance or set correct standards. Overall time may be taken by either the continuous or the non-continuous method. The overall method of taking time is admirably suited for certain kinds of time study work as will be illustrated later in this chapter, but for general purposes it is not desirable.

Continuous Method of Taking Times.—The operation is analyzed into its elements, care being taken to ferret out all standard elements and if it is a machine operation, each individual "cutting" time. For example, elements #3 and #5 in Figure 125 should be kept as separate elements and labeled whether hand or power feed is used and if the latter, what amount.

The time study observer carefully following the cycle of the operation, starts his stop watch by pushing the winding stem at the instant the worker begins doing the first element (see Figure 125). The instant the worker completes the first element the time study observer pushes the escapement button on the side of the watch near the stem, which stops one of the long hands which are ticking off the hundredths of a minute. The time thus indicated by this hand (0.06 of a minute in this case) is recorded in the appropriate space on the time study form. As soon as this has been done the observer again pushes the side escapement and the long hand springs ahead to its companion hand, and both continue to travel together. The instant the worker completes the second element the side escapement on the watch is again pushed and the cumulative time (0.10 of a minute in this case) is recorded accordingly. Similarly, the cumulative time at the completion of each succeeding element is recorded until the last element has been completed (1.03 minutes in this case), but instead of stopping the watch here it is allowed to continue to run. When the worker completes the first element on the second consecutive piece the side escapement is pushed and the cumulative time recorded (1.10

OBSERVATION SHEET

Date *Sept 20, 1927*

Part Name *Rear Axle Shaft*		Material *Ch. Ni. Steel Forging*	Part No *304974*
Oper. Name *turn spline end 1.225" diam x 2 1/8, turn flange to 1 7/8" D / Turn 1.574" D x 2 1/16, turn spline end to gage length + chamfer*		No. *30*	Dept *67-B*
Man's No. *15682*	Qual. *Good*	Model *20-all types*	No. Per Car *2*
Mach. *Lo-Swing Lathe*	No. *5195* Feed *#40*		Speed *120 R.P.M. -62 cut ft*
Mach. Floor Space *40 sq ft*	Length *10 ft*	Width *4 ft*	Is Floor Obstructed *by post*

Detail Movements	I	II	III	IV	V	VI	VII	VIII	IX	X	Min Time	Avg Time	Standard Time
			Individual Times Upper Blocks / Cumulative Times Lower Blocks										
(1) *From stand at left in machine, tighten center*	32	(B) 55	30	21	29	23	(D) 288	29	26	26	21	27	25
	32	280	714	1006	1325	16.15	2188	2517	2829	3130			
(2) *Gage length of flange*	10	(B) 13	11	09	10	09	12	10	09	10	09	10	10
	42	293	725	1015	13.35	16.24	2200	2527	2838	3140			
(3) *Start machine Run up tool in position*	13	12	13	10	10	11	08	09	09	10	08	.105	10
	.55	4.05	738	10.25	1345	1635	2208	2536	2847	3150			
(4) *Spot flange for length (Hand feed)*	.15	17	20	17	16	22	17	22	18	23	15	189	17
	.70	422	758	10.42	13.61	1657	2225	2558	28.65	3173			
(5) *Reverse tool, adjust steady rest*	.29	28	33	35	24	27	25	27	33	27	24	.288	28
	.99	4.50	7.91	1077	1385	16.84	2250	2585	2878	3200			
(6) *Run up tool in position, start power feed*	12	(A) 06	11	13	10	12	15	12	11	11	10	12	12
	111	456	802	1090	13.95	1696	2265	2597	2909	3211			
(7) *Turn flange to 1 7/8" D, turn 1.574" D x 2 1/16", turn spline end to 1.225" D x 2 1/8" (Power feed)*	.77	(C) 91	79	82	.83	78	82	83	81	84	77	81	81
	188	547	881	1172	1478	1774	2347	2680	2990	3295			
(8) *Stop machine, release steady rest*	(A) 10	18	15	15	19	18	(B) 23	16	17	20	.15	173	16
	198	565	896	1187	1497	1792	2370	2696	3007	3315			
(9) *Gage length over all*	.06	05	05	.06	(B) 13	(B) 17	05	04	04	05	04	05	05
	204	5.70	9.01	1193	1510	1809	2375	2700	30.11	3320			
(10) *Run up tool in position Start mach.*	(B) 23	11	10	10	09	11	.11	09	10	11	09	102	10
	227	581	9.11	1203	1519	18.20	2386	2709	3021	3331			
(11) *Spot spline end for length (Hand feed)*	02	.04	.05	02	.02	(A) 01	02	02	04	03	02	.029	03
	229	585	9.16	1205	1521	1821	2388	2711	3025	3334			
(12) *Run out tool, - run up tool in position*	.04	05	06	05	06	05	.05	(E) 07	06	05	04	.052	05
	233	590	9.22	1210	1527	18.26	2393	2720	3031	3339			
(13) **Cut to length 26 11/32" from flange (Hand feed)*	.51	43	18	.40	18	.30	44	30	28	31	18	333	*33
	284	633	940	1250	15.45	1856	2437	2750	3059	3370			
(14) *Run out tool, - run up tool in position*	09	.07	08	10	08	10	09	08	10	08	07	.087	08
	293	640	948	1260	1553	1866	2446	2758	3069	3378			
(15) *Chamfer spline end 45° 3/32 (Hand feed)*	06	05	07	06	.09	.07	05	07	06	06	05	.064	06
	299	645	955	1266	1562	1873	2451	2765	3075	3384			
(16) *Run out tool, - stop machine*	(A) 06	.11	10	09	08	11	11	10	08	11	08	099	10
	3.05	6.56	965	1275	1570	1884	2462	2775	3083	3395			
(17) *Release center, out, on stand at left*	20	(E) 28	20	21	.22	16	.26	(E) 28	21	25	.16	227	21
	325	6.84	985	1296	1592	1900	2488	28.03	3104	3420			
Gage every fifth piece --- gaging time 0.25 min per													05
Totals	3.25	359	3.01	3.11	296	3.08	5.88	315	3.01	316	242	310	305

Time Lost and Reason		
(A) Abnormally fast	Allowed Lost Time Per Hour *10% (Handling)*	22
(B) Simply slow = avoidable lost time	Set Up Time *(Tool time) 10% (Mach.)*	08
(C) Cut air = avoidable	Allowed Time Per Piece	3 35
(D) Oiled countershaft -- not necessary	Piece Work Price *P.W. 65¢*	$3 61/c
Note Greater care required in element (6) than in (3) or (10)		
** Large variation in time is due to varying amount*	Quantity Per Hour	18
of stock removed -- allowable	Quantity Per Shift of Hours *8.6*	155
Note Greater care is required in element (4) than (12)	Man's Rate Per Hour *D.W.*	47 1/2¢
Note: Operator changes driving dog while power	Present Quantity Per Hour	8
feed in element (#7)	Present Labor Cost Per Piece	$5.94/c

Agree Machine is set at Most Efficient Speed and Feed and Production is O K. *Joe Bruche*

Finished Part Goes to Dept. No. *45 - Basement -- Stock*

(E) Gaged piece *W.B. Glenroe* Observer

Figure 126. A Time Study. Illustrating a method of handling foreign movements and abnormal times

minutes in this case), and so on for as many consecutive pieces as have been previously decided upon to include in that particular study. In this way, the cumulative time for each element covering the entire study has been recorded in the lower blocks as shown on the time study form. If, during the recording of any of these times, the time study man observes any foreign movements on the part of the operator or a slowing down of the machine, he takes the times of the elements as usual, including the foreign movements, and indicates the fact by a code letter alongside of those times. At the bottom of the time study form he explains the causes of the foreign movements and whether or not they were necessary (see Figure 126).

Number of Consecutive Pieces to Time.—As to the number of pieces that should be timed, this varies according to the nature of the task and surrounding conditions. Standards may be set by timing only one piece, but this should always be avoided when possible. On very long tasks under certain circumstances the timing of four or five complete consecutive cycles may be quite sufficient, while on very short operations forty, fifty and often more complete cycles may be necessary. However, experience has shown that on most operations the timing of ten consecutive cycles gives as accurate results as though double or more cycles had been timed. For that reason time study forms are usually printed with sufficient columns to permit the timing of ten pieces or cycles.

There are rare cases where, due to different variables entering into the task at long and irregular intervals, it may be necessary to make a continuous time study extending at least ten days so as to include the daily happenings in the shop over at least two week-ends. More frequently, yet still more or less rarely, it may be necessary to make an all-day or a half-day time study. These, however, are usually taken for the purpose of checking or proving the correctness of a former study.

Computing Times of Individual Elements.—In writing-up a time study, the first step after the cumulative times have been recorded is to compute the times of the individual elements. This is done by subtracting the cumulative time of one element from the cumulative time of the following element. This is clearly shown in Figures 125 and 126. The individual times for each element on all pieces are computed and recorded in the upper blocks directly above

the cumulative time for the respective elements. A glance along the horizontal column at the right of each element shows how uniform the operator performed that element in each of the pieces or in each cycle of the task completed. If any of the times of any of the elements are abnormally high or low they should be crossed out or inscribed in a circle or square as shown in Figure 126. In no case should these times be obliterated, as they will be studied later. As already explained, when recording the cumulative times the time study man, at the time it occurs, indicates by means of a code letter any foreign movement or slowing down or speeding up that he may observe. Therefore, when the times of the individual elements are "pulled," a code letter would be found with all abnormal times. All abnormal times should be omitted when computing the three columns —minimum time, average time and standard time.

Computing the Standard Time.—It is obvious how the times in the minimum and average columns are determined. The times in the standard column must be computed with the greatest of care. It must be remembered that the purpose of time study work is primarily to facilitate production and that production is obtained through the efforts and skill of human beings. In production work it is not possible to secure men for all work who are ideally suited for that work. Through necessity poor workers will be assigned to some operations or tasks, while on other tasks there will be mediocre workers, good, average workers and superoperators. It will be necessary, then, to take the times on all sorts of classes of workers. The poor or slow operator may take 40%, 60% or even 100% longer than would the average skilled operator. Standard times should always be set using as a basis the average skilled operator. Therefore, in determining standard time, the degree of skill of the operator studied and the amount of effort expended in comparison with that of an average skilled operator must be taken into consideration as well as the working conditions under which the operation is performed. For this reason the average time as appears on each study sheet must be tempered accordingly—decreased, increased or remain the same, depending upon the case in question.

Some persons advocate using the average time as the standard. This would be satisfactory if all observations were made on an average skilled operator, but this is not the case. Therefore, a large bulk

of the standards thus set would not have included a proper appraisal of skill and effort upon which true results depend. Other persons advocate using the minimum time, but here again skill and effort are not taken into consideration. Others advocate using as a basis the length of the operation and the consistency at which the operator worked and performed the individual elements. However, time study men know from experience that a skilled operator can purposely slow down in performing a task and yet maintain just as perfect consistency in his motions or rhythm in performing the elements and the operation as a whole as when he is working at his normal or average full speed. Other authorities advocate using good judgment, but this is rather broad and indefinite as it depends entirely on the extent of experience of the time study man and on his consistency in using good judgment. There may be several time study observers in the same plant, in which case the good judgment of one observer is rarely, if ever, exactly the same as that of another, therefore the standards set by one time study man may not be entirely consistent with those set by another; that is, the standards set by one man may or may not be either tighter or looser than those set by another. There is no question that judgment does play an important part, but in every case this judgment should be guided if satisfactory results are to be obtained. On account of the extent to which the subject would have to be discussed, it is not within the scope of this book, to go into the detailed technique of the grading process in setting standard times. Such discussion may be found in any good book devoted exclusively to the subject of time study. There is an exception in which no grading should be made and the average time always given. This exception is in machine operations, and is in all elements covering the actual "cutting time" when power feed is used.

Allowances.—By adding the standard time of all elements of an operation, the total time for the task is obtained. This, however, is a flat basic time and does not allow for a worker to stop to rest for a few moments now and then, nor for personal needs or other necessary delays. To the standard basic time should be added a definite allowance to cover fatigue, personal needs and special requirements peculiar to the task such as set-up time, sharpening and changing tools, gaging, etc., and for delays beyond the control of the worker, if there are any. The allowance for personal needs covering

a day's work would be the same for all tasks. The allowance for fatigue varies with the kind or nature of work and with the particular operation. For certain classes of work formulas and curves have been worked out for determining the amount of time to allow under varying conditions. However, care and good common sense should be exercised in the use of all such formulas and curves. In regard to the amount of additional time to allow on account of special conditions and unavoidable delays beyond the worker's control and for set-up time if required, this, too, will vary with the nature of the work and with the particular task. Usually for each class of work allowances can be determined and expressed as a flat percentage to be added to the standard base time. Space does not permit a detailed discussion as to the method of computing allowances above mentioned. Any good text devoted solely to time and motion study work covers in detail the question of allowances.

In writing up a time study it is advisable to list separately on the time study form the standard base time and each allowance given, stating the reason for giving it and the amount of time allowed.

Allowed Time.—The standard base time plus the allowances equals the allowed time per piece or job. This time should be set so that with the material, equipment and tools furnished and following the methods laid down for him, the average skilled operator working under average conditions can accomplish the task and maintain the standard of quality when exerting average effort, which he can keep up day after day without injury or risk to himself or fellow workers.

Checking and Approval of the Study.—When the allowed time per piece or task has been determined, the quantity per hour figured, and all other data called for on both the front and reverse side of the time study sheet have been entered, excepting the piece-work price or the money to be paid the operator for the performance of the job, the study should be submitted to the time study engineer or whomever may be in charge of the time study section for his scrutiny and approval. Next, it may be desirable to submit the study to the foreman of the shop in which the operation is performed. It is not uncommon to find that the quantity per hour called for on the time study is 50%, sometimes 100% or even greater than that which has been accomplished in the past. If the foreman has not been present and seen the study taken or does not understand how the study was

written up and what allowances had been given and the amount of each, it might be difficult for him to believe that the allowed time and the quantity per hour called for on the study are fair and reasonable. It is for this reason that it is advocated that the foreman be present at all jobs when studies are taken until such time as he becomes familiar with the time study work being carried on and gains complete confidence in the ability and fairness of the time study man. If the foreman, after examining the study, has no suggestions to make regarding the speed and feed used, allowances given, and so on, he signs his name in the proper space at the bottom of the time study form. This signifies that the foreman, too, agrees with the study in every respect and that, in his opinion, the task as indicated on the time study sheet is being performed in the most efficient way possible under existing conditions. This agreement, then, places the responsibility on the foreman, the line man, to put these standards into use and see that the operation is accomplished accordingly as soon as the rates are released by the time study section and become effective.

Setting the Piece-Work Price or the Incentive.—After the foreman has approved the time study it is returned to the time study section where the piece-work price or other incentive wage is calculated and assigned. For obvious reasons the piece-work price or incentive wage is not assigned until after the study has been approved for time and production standards by all concerned. The standard rate of production set or time allowed and the incentive wage given for a task should accurately reflect the relative importance of time, quality of work and value of the material of which the article is made, including the labor and overhead cost already worked into it.

A piece-work price, that is, the incentive wage, should never be cut unless there is a sufficiently great change in the economic value of the dollar to warrant a general reduction in the entire wage scale. Piece-work prices once set should be guaranteed for a definite length of time. If a standard time has been set too loose and the resultant piece price too high, the only way the price should be changed is by studying the operation until a new method of doing the task is developed that will materially increase its efficiency. The change should be more than a technicality, the operation should be materially improved in one way or another. If this principle is not carried out the morale of the workers will be broken, production restricted and the

purpose of the incentive defeated. Guaranteeing prices will also cause the time study men to take the greatest of care in all their work.

Typing the Route Sheet.—For convenience in reference during this discussion, it is assumed that the incentive wage system employed is straight piece-work. The piece-work prices for the several operations having been set, the time study section then types the route sheets, a copy being sent to the foreman, or if the production booth system is in use the copy would go to the booth man where it could also be used by the foreman. Another copy would be sent to the cost division and other copies to other persons authorized to receive them. Care should be taken in typing the route sheets to be sure that they correspond exactly with the operations covered and the standards set, as given on the time study sheets. It is necessary to have the two correspond in every detail at all times, then, if for any reason an operation is changed in the shop without notification being given to the time study section, it will sooner or later come to light, at which time the piece-work price should be cancelled and the job retimed. Inasmuch as the name of the operation is given in such detail on the route sheet and on the time study form, the change will be so obvious that neither the foreman, worker nor anyone can have any legitimate objection for such action being taken.

The Route Sheet.—It is now in order to point out other important things on the route sheet that were not covered when discussing this form in Chapter XXV. Referring to Figure 89-B showing sheet #3 of the routing, note that after the description of operation #190 there is typed on the route sheet the statement "one man runs 4 machines." Also note the statement typed directly under the figures giving the standard time and the production per hour.

Again, read the description of operations #210, #220, #230. Note the complete way in which the description of the operation is given, even to stating the limits specified on the job. Unless otherwise stated as is the case in operation #220, only one piece is made at a time. Also note that when doing operation #220 the operator must also do either operation #210 or #230. The reason for this is because the cutting time (power feed) in operation #220 is sufficiently long to permit the operator to do either one of the other operations while the cut is going on and yet not be delayed or prevented from turning out maximum production on operation #220. All this information should

be clearly stated both on the route sheets and on the time studies. Incidentally, in such cases the piece-work prices purposely have been set so that the operator must do the combination of operations as stated, otherwise it would be impossible for him to earn day wages for his day's work. On account of performing two operations at the same time or operating more than one machine, even though they are simple operations the worker should be given an additional incentive. In this case the prices were set so that the worker could earn about 10% more.

When an operation has not been studied and has not been put on a piece-rate basis, then, for the purpose of giving the cost accounting division proper information, the estimated day-work production and cost should be entered on the route sheet as shown in operation #70 (see Figure 89-A).

The object of numbering operations 10, 20, 30, and so on, instead of 1, 2, 3, 4, etc., is to facilitate matters, for if through time study or otherwise it is found desirable to split an operation, or should it become necessary to add extra operations, it will not become necessary to renumber the entire routing. If for any reason an operation is cancelled or combined with another operation, it should not simply be dropped, but should always appear on the route sheet for the purpose of future reference (see operation #270, Figure 89-C).

The Allowance Slip.—After a task has been studied and a rate set on it, the task should be put on an incentive basis and always performed on that basis thereafter. However, there may be times when this would be impractical. A jig or fixture may break and a makeshift arrangement may have to be used until repairs can be made, or possibly a machine may break down and no other like machine of the same capacity available to which the operation could be transferred. The work must be done, but due to one reason or another the operation when performed with the substitute equipment or on the substitute machine is much slower. It may be that the operation will have to be performed temporarily by an entirely different and slower method. It must be remembered that a foreman should not be permitted to run any operations in his shop that are not listed on a route sheet. Such a rule strictly adhered to will do away with a great many undesirable and costly things which are more or less common practice in many shops. However, there must be a method devised to care

for temporary operations which through necessity have had to be added and to care for other emergencies. The foreman in such cases, by means of a request for time study form, notifies the proper person in the time study section. The latter investigates the situation, and if he agrees with the request issues an "Allowance Slip" (Figure 127) to cover the emergency. In every case, in so far as it is possible the new temporary rate as granted by the allowance slip should be set on an incentive basis. These slips are printed with red letters on

ALLOWANCE SLIP
Production Engineering

Factory No.______ Dept. No.______ Oper. No.______ Model No.______ Sched No.______

Part No.______ Part Name____________ Pcs. Per Job______

Date Effective____________ Void After____________

This Slip to be Used When Conditions in Shop Will Not Permit Time as Shown on Piece Work Rate Schedule to be Effective. Conditions Must be Stated in Detail Below with Price Allowed. Per cent Over Base Rate, Estimated Earnings.

Base Rate______ Prod. Per Hr.______ Study Price______ Allowed Price______

Per cent Increase____________ Estimated Earnings____________

SIGNED SUPT. APPROVED P. W. SUP'R

Figure 127. An Allowance Slip Form

white paper, the left edge of which is gummed for the purpose of pasting them on the edge of the route sheets. An allowance slip is made out to cover the estimated length of time of the emergency in question and becomes void on the date specified on the slip. Should the emergency be over before the estimated date as given on the slip, the foreman should immediately notify the time study section so that the allowance slip may be promptly cancelled. Copies of allowance slips are sent to the cost accounting division, the foreman and all others who receive copies of the route sheets on which the temporary allowance slip has been issued. Note carefully the information called for on the allowance slip illustrated.

A Production Time Study.—Now and then a case will arise where a foreman, after an earnest endeavor, is unable to get an operation running satisfactorily in accordance with the standards set, in which case he may request a new study to be made so as to check the present rates. Then again, a worker or group of workers may enter a complaint to the foreman, or through their representative to the industrial relations division to the effect that certain rates are too tight and are unjust. Such or similar difficulties are liable to occur at any time on any task. It is the duty of the time study men immediately to justify and completely prove the correctness of the standard set, and if they cannot, then rectify their error. At such time the thoroughness and accuracy of the time study man's work stands out in bold relief. Regardless of how long previously the time study may have been taken, it should be in such detail that no important question can be asked in regard to the operation or task that cannot be conclusively answered. This is one of the reasons why so much stress was placed on the necessity of using proper technique in the preparation for the taking and the computing of time studies. It is far better to take a fewer number of time studies per day and use correct technique than to try to take a larger number of studies and thereby employ loose or poor methods.

In some instances the time study man, before setting standards on certain important tasks, may want to check himself and prove his former study. In all questionable cases such as those above mentioned and other similar ones, some satisfactory method of proving must be devised. One way is by making an all-day time study or "production time study," as it is often called. These studies may extend over only a few hours, or they may cover an entire day or perhaps ten consecutive days to include the variables or happenings which enter into the task over the week-ends.

In taking a production time study the time study man should be at the place where the task is performed at least a quarter of an hour or more before the starting whistle blows in the morning so as to observe, before the operator starts his day's work, any possible variables which may have a bearing on the case. From the instant the starting whistle blows, the time study man must make an accurate accounting of everything that goes on during every minute of the entire duration of the study. A simple illustration and brief description will bring out the essential details sufficiently for the purpose of

this discussion. The time study was of operation #120, "Turn to 1.327″; 925″; 890″ Diam. and chamfer end" on part #300802-3, "Steering Knuckle and Bushing Assembly."

Some three weeks after the standards on this operation had been set and the rates had become effective, the time study section was called upon to prove the correctness of the standards or to revise them to what they should be. After carefully reviewing the original study and again checking the operation, the time study man could find no error, although the claim had been made that sufficient allowances

SUBJECT:—Production Time Study for Five (5) hours—7 A.M. to 12:00 Noon. Details and Summary. Operation #120—Turn to 1.327, .952, .890 diam. and chamfer end.

PART #300802–3
PART NAME—Steering Knuckle and Bushing Assembly—Model 6
DEPARTMENT #50
December 10, 1927
SERIAL #351

OPERATOR'S NUMBER: 26549 MACHINE NO. 783 LO SWING LATHE

No. Pcs.	Time	Individ. Time	Lost Time	No. Pcs.	Time	Individ. Time	Lost Time
	7:00.00		Start	35	7:28.45	.75	
1	1.18	1.18	Oil mach.	36	29.21	.76	
2	1.92	.74		37	30.97	.76	
3	2.64	.72		38	30.71	.74	
4	3.42	.78		39	31.45	.74	
5	4.16	.74		40	32.21	.76	
6	4.92	.76		41	32.95	.74	
7	5.61	.69		42	33.68	.73	
8	6.34	.73		43	34.43	.75	
9	7.05	.71		44	35.16	.73	
10	7.77	.72		45	35.90	.74	
11	8.51	.74			36.54	.64	Change one tool
12	9.27	.76		46	37.28	.74	
13	10.02	.75		47	38.02	.74	
14	10.74	.72		48	38.75	.73	
15	11.45	.71		49	39.71	.96	
	13.90	2.45	Get stock	50	40.43	.72	
16	14.64	.70		51	41.15	.72	
17	15.36	.72		52	41.86	.71	
18	16.07	.71		53	42.56	.70	

Figure 128. A Production Time Study

to cover variables had not been given. It was readily agreed between the operator, the foreman and a representative from the Industrial Relations Division and the time study man that all variables entering into the operation would be encountered between starting time in the morning and quitting or lunch time at noon. A production time study covering such a period was decided on and run the following morning. Figure 128 shows the first of the five sheets which comprise the detailed production time study of this operation. The time study man started his watch at 7.00 A.M., the instant the whistle blew, and did not stop it until the whistle blew again for lunch time at noon.

Each time the operator completed a piece the time study man pushed the small escapement attachment at the side of the winding stem on his stop watch so as to stop the auxiliary hand, thus permitting him to record the exact time the piece was completed. While the operator was working on the next piece the time study man would quickly "pull the time," that is, compute the overall time for the one cycle of the complete operation. This was done for the time study man's information to see how uniformly the operator was working. Each time an abnormal "time" or cycle occurred, the time study man would make notation of the cause in the "Lost Time" column. At intervals during the study the observer would check up the feed and speed used, the cutting time, and so on. At the close of the study a complete summary was made in which was an analysis showing the proper distribution of "lost time" as shown on the study sheets among the several variables entering into the operation, such as handling stock, sharpening tools, and so on. A comparison was then made between the actual amount of time consumed by these variables and the percentage originally allowed as shown on the time study. It is interesting to note that in this case the production time study checked almost identically with the original time study.[4] As a result of the production time study no change in standards was made. The operators, apparently satisfied that the standards were correct and that no change in them would be made went after the job, and as shown by the company's time records each day thereafter the operators beat the production set by from 5% to as high as 11%.

Establishment of Base Rates.—This leads to another very important point. Previously it was mentioned that the time study men should think and talk in terms of standard time and standard rate of production only—never in terms of wage rates, piece-work price or whatever incentive wage system may be in use. The day-work rate of

[4] Comparison between original time study and results of actual trial as shown by production time study follows:

	Prod. per hr.	Std. time per pc.	Allowed time (or ave. time)	Allowances			
				Stock, oiling, etc.	Personal	Tools, etc.	Total
Original Study........	65	.73 min.	.923 min.	4½%	5 %	17 %	26½%
Actual Trial..........	65½	.738 min.	.914 min.	3.92%	5.4%	15.7%	25 %

pay given for each kind and class of work and the amount of incentive to be given above that day work rate of pay, whether that incentive be in the form of piece-work or a bonus is a matter for the management to decide. The time study section and the foremen should be permitted to make their recommendations in regard to such matters, so should the industrial relations division and the employees themselves through their representative, if employee representation exists in the concern. Job analysis, the establishment of job classifications, the assignment of a fair day wage rate and equitable piece-work or other incentive rates for each class of work and the intelligent grading of every task so it will be assigned to the proper classification are basic. When this has been done and correct time standards or standard rate of production set, it is a simple matter to compute the piece-work or incentive price.

The establishment of base rates of pay by the management relieves the time study section from getting into unnecessary jams with the foremen, operators and others, and places the final responsibility of deciding what the wage rate of pay should be squarely up to the proper managerial authorities. Job classifications and base rates of pay as above indicated should be put in writing by the management so there can be no possibility of misunderstanding. In some instances, in order to assure harmony it may be advisable for each foreman, the division superintendents, employment manager and employee representative of each shop or section to signify their agreement with the classifications and rates by signing their names to the classification list along with the signature of the head of the industrial relations division, the works manager and possibly the vice-president in charge of manufacturing.

Synthetic Time Study.—It is not necessary to make individual time studies of each specific job. A task need not be actually performed or a part be in production in order to make a time study, set standards and assign a piece-work price or other incentive wage. Earlier in this chapter it was explained how an operation or task is made up of elements and the desirability of developing "standard elements." By studying each class of machine or equipment, a set of standard elements can be worked out for each class, time studies taken and the results tabulated for future use. In this way it is possible to cover practically all operations which would be done on those

machines. For example, every job done on a boring mill includes certain standard elements. First, the operator takes the necessary tool and wrench from the stand, second, he puts the tool in the post, third, he tightens the set screw that holds the tool, and fourth, he replaces the wrench on the stand. By taking time studies of these elements on each size of boring mill used in the shop and tabulating the results, the studies are completed once and for all. If the time is being set for a new job to be done on a boring mill a practical man can take the lists of standard elements and their times, and by computing the cutting time as described in the chapter on routing can build up a synthetic time study of the task direct from the blueprint. Times and production thus set are surprisingly accurate. In this way time study may be successfully carried on in jobbing shops, thus permitting of more accurate and successful planning than would otherwise be possible.

CHAPTER XXX

WAGE SYSTEMS AND INCENTIVES

Wage Rates and Their Importance.—To the average workman the question of wages is of first importance in his relationship with his employer. Good working conditions, fair hours of work, steadiness of employment, the opportunity for advancement and the quality of leadership on the part of the supervisors, all are important but they are not complete in themselves. If the wages are not "right" the working force will be discontented and a high rate of labor turnover is bound to result.

If workers get higher wages, they have more money to spend. If they can supply their needs at reasonable prices, the surplus remaining after providing for bare necessities can be spent upon what until then have been luxuries beyond their reach. They can purchase a piano, a radio, an automobile or any of the many luxuries that are denied to workers in practically every other country but ours. To meet this demand goods are produced in larger quantities with the accompanying economies which result from mass production. With reduced costs of production goods can be sold at lower prices, thus permitting of their purchase by a still greater number of persons. With mass production the individual worker produces more, he is paid higher wages and the purchasing power of those wages is greater due to the lower price of goods. Thus, the standard of living is raised for the masses.

For the individual workman, his wages determine his scale of living and that of his dependents. The dollars and cents received for his efforts must be adequate to take care of his needs and be a fair return for his efforts or else the workman will be dissatisfied, will perform his work in a half-hearted manner and will change his job at the first opportunity. Low wages are often a false economy resulting in low output, poor workmanship, strikes and labor troubles in general. The employer who forces the wage rate down to the very minimum cannot attract or hold good workers. He may pay low wages but that does not mean that his costs are low. The only

workers he can get are those who are not wanted by the more efficient plants. Modern management appreciates the common sense of paying high wages, and then seeing to it that its equipment, methods and supervision are such that it gets the service for which it pays. Wages should not be figured as dollars and cents paid for a man's time, but as dollars and cents paid for service or accomplishment. If you buy goods for a dollar and expect to get a dollar and a quarter's worth you will be disappointed. Similarly with wages. On the other hand, exorbitant wage rates result in excessive production costs, decreased profits and frequently actual loss. To pay labor more than the market price is just the same as paying more for goods than they are worth. This is courting disaster for both employer and employee. For the former it tends to wipe out his profits, for the employee it results in ultimate unemployment, as no employer can afford to continue to pay wages that are not earned.

"Right" wages, which give a man a dollar, no more and no less, for every dollar's worth of work he gives, attract the right kind of applicants and aid in maintaining a loyal and efficient working force. All wage rates should be set with equal justice to employer and employee—the employee to receive a fair return commensurate with his efforts, the company to secure the greatest possible production at the lowest possible cost, quality of the product and local conditions considered.

Factors That Control Wages for a Particular Plant.—Labor believes that employers fix wages as low as possible, driving a hard bargain in order to reap huge profits for themselves. Employers believe that labor is continually trying to force wages higher than is economically sound, thus resulting in excessive costs and eventually industrial depression. The truth is that neither labor nor employer can arbitrarily fix wages without menace to industrial prosperity. There are economic laws which cannot be disregarded by either side without injury to not only one side but both.

The factors that control wages for a particular plant are:

1. Conditions of the Labor Market.—When business conditions are good and workers are in demand the price of labor rises; conversely, in times of business depression lower wages prevail. It is necessary, therefore, to take into consideration the three following factors:

(a) General business conditions
(b) Conditions in the particular industry
(c) Local conditions

General Business Conditions.—When there is a nation-wide depression, as in 1921, there is a greater supply of workers than industry can use, and wages fall. This permits those plants which can find a market for their product (domestic or foreign) to produce at a lower cost and thus secure a wider distribution than they formerly had. To turn out the greater volume more workers are required. Gradually, industries begin to come back to normal, the surplus labor is absorbed and wages cease to fall. As prosperity increases the demand for workers increases until the demand is greater than the supply and wages rise until wages and production costs get so high that prices become prohibitive, and demand for products falls off again.

Conditions in the Particular Industry.—When there is a depression in a particular industry as, for example, the recent depression in the woolen industry, a plant in that industry has at its command more workers than it can use. Even with general business conditions good, workers in one industry may find it difficult to obtain a good job in another industry. The average weaver would require training before he could secure a job in a machine shop. Two factors tend to make the worker desirous of keeping in his own industry even at the expense of a lower wage. The first, the fact that he may have to move to another locality in order to get a job, and second, the dislike of change and fear of failure in learning new work. These factors are more pronounced among the older workers. The younger workers are not so loath to change their locality or their kind of job. Mass production with its division of labor carried to the point of performance of but one, two or, at the most, a few operations has made the learning of a new job a comparatively simple matter and has thus reduced to some extent the effect upon wages of business conditions in a particular industry.

Plants in those industries which are decidedly seasonal in character must pay higher wages than other plants in order to compensate for the period when the workers are out of employment. Extra inducement must be offered as the average workman prefers continuous employment even at less pay.

Local Conditions.—A plant cannot expect to attract a high grade of workers unless wages paid for a given class of work are up to the prevailing standard of wages in that community. If the plant is not conveniently located, or for any other reason it is not so desirable a place to work as other plants in the same locality, the plant will have to pay a higher wage rate than the prevailing standard wage rate. Many of the more progressive plant executives advocate paying the standard wage rate in that community for a given class of work and, in addition, offer an incentive for extra effort.

2. The Cost of Living.—This element forms the basis for minimum wage laws and is a prime factor in all labor controversies. The Philadelphia Rapid Transit Company, which has made such notable progress under its present management, has a wage system under which changes in the wage base are in accordance only with the rise or fall in the purchasing power of the dollar. The following is an extract taken from a description of their wage payment plan and its operation:

Wages shall be determined for each class of employees upon the basis of a fixed rate established by the general committees;[1] changes in the wage base thereafter to be in accordance only with the rise or fall in the purchasing power of the dollar. Such changes shall be in relation to the changes in the composite cost of various standard market baskets, as determined upon by the general committees and adjusted from time to time as they may agree.

For this purpose, a number of varied market baskets with fixed contents have been prepared, the prices of which are determined from month to month by a bureau working under the direction of the general committees. The wage paid shall be adjusted upward or downward so that at all times the contents of the pay envelope shall be sufficient to buy the same number of standard market baskets regardless of the changes in their prices upward or downward, to the end that, no matter whether the prices that have to be paid for the necessaries of life rise or fall, the employees shall always receive a wage sufficient to maintain their standard of living at its present level.

Wages shall be determined by the general committees at the first of each year for the ensuing calendar year. At such regular annual determinations, adjustments shall be made only when the purchasing power of the dollar varies 5 points or more from the market basket index at the

[1] Management and employees are equally represented in the general committees.

last previous adjustment. Adjustments shall be made proportionate to the rate for each occupation.[2]

3. Conditions Within the Particular Plant.—General working conditions, the skill or effort required on a particular job and the conditions surrounding that job are factors of considerable weight in controlling wages. Wages should increase as the work requires more physical effort, is more disagreeable or hazardous or requires more thought or skill. Tool making, for example, requires mental effort and skill in addition to manual effort. The tool maker, therefore, should be paid high wages in comparison with those paid a lathe hand doing repetitive work. The lathe hand, in turn, exerts more mental effort and skill than the sweeper or general laborer and, therefore, should receive higher wages than the latter men do. In all cases, the wages paid should be according to the amount of physical and mental effort required and the degree of skill necessary. Similarly, conditions of excessive heat or cold, disagreeable or unhealthful fumes and odors, fire hazards and so forth all tend to make the work less desirable and must be counteracted, in so far as is possible, by concessions to those men such as the payment of higher wages than would be paid under more desirable conditions.

4. Standard Wage Rates of Payment Prevailing in the Plant.—The scale of wages is based upon the three preceding factors and the financial condition of the company. Any deviation from the standards set breeds dissatisfaction among the workers. Inequality in wage rates for workers doing the same class of work is quickly detected and resented. If a foreman in a shop in trying to keep his costs down pays his men less than another foreman in the same plant pays his men for the same class of work, production in the first shop is bound to lag behind or be of poorer quality and labor troubles begin to be felt. The radicals in labor are always on the alert for any inequalities shown. With the workers feeling an injustice is being done to them they are in just the frame of mind where they will listen to the radical. He stresses their grievance and enlarges upon it and labor troubles are fast under way. The way to deal with labor troubles is not so much to try to find a solution as it is to guard against any mistakes on the part of management, which might tend to cause them. Wages is the battle ground upon which most of the

[2] The Mitten Plan for Collective Consideration and Cooperative Benefits, The Philadelphia Rapid Transit Company, 1926.

strife between employer and employee is centered. Standard wage rates should recognize and provide recompense for the degree of skill required, both mental and manual, and the quality and quantity of the work produced. No deviations except as to variations of the above factors should be permitted.

Basic Considerations in Adopting Any Wage System.—The solution of the wage problem for a particular concern lies not in the arbitrary selection and adoption of some one wage system which has worked out to advantage in other concerns, but in the careful study of all systems in the light of their suitability to meet local conditions. A plan that is eminently fair to employer and employees under a given set of conditions may be decidedly lacking in this quality under another set of conditions. Likewise, a plan that stimulates one class of workers to do a full day's work may not provide the right incentive for another class of workers. In every plant there are manual workers and mental workers. Even among manual workers there are distinct classes. There are skilled workers and unskilled workers and in most plants there is a class which falls between the two and which might be termed "semi-skilled." The wage system adopted should take into consideration the needs of these several classes. It is not at all unusual, therefore, in fact it is quite customary, to find in the same plant two or more wage systems, each operated to meet certain conditions.

A wage system to be effective must provide for the following elements:

1. Based Upon Fair Standards of Accomplishment.—That is, standards representing what the average workman can accomplish in a given time under existing conditions, consideration being given to the relative importance of the three factors, quality, quantity or output and economy of materials used. Standards set by guess or based upon past performance alone are not true standards of accomplishment. Time and motion studies of the performance of the average skilled operator on a given job should be made by an experienced, practical man. These include a study of the machines, tools and equipment used, the materials worked upon, the sequence of operations, the method of work, factors of fatigue and other allowances necessary. Unless standards are so based and are figured accurately,

they are not fair to anyone concerned and the wage system based upon them cannot be truly effective.

2. Acceptable to Both Employer and Employee.—No matter what system is used, the cooperation of both employer and employee is needed if maximum benefits are to be derived. To secure this essential cooperation the system must be fair to both. If the system does not secure the output required at a production cost which permits of a suitable profit to the employer, the system is not fair to the employer. If the average worker is not paid a reasonable return for his efforts and if the more capable worker is not permitted to earn comparatively high wages, the system is not fair to the workers.

3. Labor Remunerated on the Basis of Accomplishment.—A wage system should provide additional recompense for increased production or improvement in methods. The incentives should be such as to stimulate the worker to the maximum production he can achieve without injury to himself or fellow workmen, but not to the point of overexertion or carelessness.

The amount and kind of incentive that will prove most effective varies with the kind of work the worker is doing and with the worker himself. For some workers the opportunity for advancement and continuity of employment holds the greatest inducement for best effort. Other workers are primarily interested in their pay envelope. The exact percentage by which wages must be increased in order to make the average workers work to their maximum varies from 30% to 100% more than the average base rate.

Taylor [3] found that "to get the maximum output from ordinary shop work requiring neither especial brains, very close application, skill nor extra hard work, such for instance, as the more ordinary kinds of routine machine shop work, it was necessary to pay about 30 per cent more than the average. For ordinary day labor requiring little brains or special skill but calling for strength, severe bodily exertion, and fatigue, it was necessary to pay from 50 per cent to 60 per cent above the average. For work requiring especial skill or brains, coupled with close application, but without severe bodily exertion, such as the more difficult and delicate machinists' work, from 70 per cent to 80 per cent beyond the average. For work requiring skill, brains, close application, strength, and severe bodily exertion,

[3] Frederick W. Taylor, Shop Management, Harper & Bros., Publishers, New York, p. 26.

such, for instance, as that involved in operating a well run steam hammer doing miscellaneous work, from 80 per cent to 100 per cent beyond the average."

4. Simplicity of Operation.—A wage system that is elaborate and costly to maintain defeats its own purpose. Similarly, if the wage system cannot be easily understood by the rank and file worker, it is doomed to failure. Workers object to any system under which they cannot readily compute their own wages.

5. Flexibility to Meet Varying Conditions.—Economic changes and changes in manufacturing methods and working conditions necessitate changes in the rate of wages paid. The wage system must be flexible enough to meet these changes with a minimum of extra effort, dissatisfaction and confusion.

6. Protection to Both Employer and Employee Against Unfair Conditions.—For example, provision should be made whereby the worker receives his hourly wage during such times as there is no work for him to do, due to conditions outside of his control and for which the management is responsible. Similarly, the employer should be protected against unfair conditions brought about by the employee. For example, if a worker is being paid a certain sum per piece he should not be paid if the work turned out is not up to the standard of quality that has been set.

7. Prompt Payment of Bonuses Earned.—Deferred payment, such as profit sharing at the end of the year, does not have the desired effect with the average workman. In many cases, however, it works to good advantage with foremen, superintendents, etc., who are usually men of broader vision.

Day Rate.—The oldest and simplest method of wage payment and the one in most general use is the day rate plan whereby the employees are paid a definite sum per hour, day or week, irrespective of the amount or quality of the work turned out and the general efficiency of the worker. Executives and supervisory positions almost invariably are paid by the year or by the month, clerks and other office help generally are paid by the week and manual workers by the hour.

While some executives consider a day work system for workers

as thoroughly inefficient, it has advantages under certain conditions. They may be summed up briefly as follows:

Advantages to the employer:

1. Ease of computation of wages. Simplicity and low cost of operation of the wage system.
2. The employer takes all gains through any extra productive effort on the part of the employees. With methods of selective employment, employee training, careful planning of work and proper supervision this factor, in some cases, can be made an important one.

For the employee the day wage system has two main advantages:

1. Ease of computation of wages. Workmen prefer a wage system under which they can readily compute their earnings.
2. The worker is assured a definite payment for all time put in.

The disadvantages of the day work system are marked especially in modern mass production with its specialization of labor. They may be outlined briefly as follows:

Disadvantages to the employer:

1. Employer bears all losses sustained through slowness and carelessness on the part of the workers. The average workman on day work rarely exerts himself to his full productive capacity. Unit production costs are likely to be high.
2. Accurate unit labor costs cannot be ascertained or proper estimates made as productivity varies.

For the employee the day wage holds the following disadvantages:

1. Lazy and inefficient workers receive the same pay as efficient workers, although the latter may be turning out twice the amount of work. The personal element between employer and employee is lacking in large modern businesses. In the past, the employer knew the ability of his men from his own personal observation and he rewarded them accordingly. Today, he no longer comes in direct and frequent contact with his workers; therefore, a means of

measurement of effort and a change in the method of wage payment is needed.

2. No incentive is provided to improve quality, increase output, be economical in the use of materials or raise in any way the efficiency of the individual worker. This tends to discourage the worker and to sap his ambition so that he passively drifts along without developing himself to his full capacity.

Day Rates—Where Used.—While day work in many cases is unfair to worker and employer alike and while its general use is not in keeping with the progressive trend of the times, it still holds an important place in industry. For example, in a small shop, where there is close contact between the foreman and his men, fair treatment, an adequate day wage and possibility of promotion are all that is required to make the right sort of workman exert his best efforts. In a large plant day work is the wage system ordinarily used in paying for such work as inspection, tool making and maintenance. Generally speaking, it can be said that day work is used on jobs requiring extreme accuracy rather than quantity or speed or where the work done cannot be readily measured. For example, if the work is of a very diversified character it would be impractical to attempt to measure the various kinds of work done or the time in which each job was completed. Instead of payment upon a basis of output, a day rate would be used in such an instance.

Piece Rate.—Piece rate is the oldest and most common production payment method. Under this wage plan the worker is paid a fixed rate per unit produced with no day wage guaranteed.

In order that a system of piece work payment can be made effective it is essential that piece rates be set only after careful study of all influencing factors so that the rates once set will not have to be revised. Rates should only be revised where there is a change made in the machinery, tools or equipment or the materials used or in the methods, processes or design of product. The cutting of rates breeds dissatisfaction, breaks the morale of the workers and causes them to limit production. Rates may be set based upon time studies taken of each specific job or upon synthetic time studies, both of which methods have already been described in Chapter XXIX.

"A large portion of the value of setting rates from time studies

is obtained by first improving the inefficient working conditions which the time studies reveal, but which are impossible to detect in any other way, and after the working conditions have been standardized and the rates established, there is the additional advantage of knowing that these rates are fair to employer and employee." [4]

The piece rate set should provide the necessary incentive above a fair day wage that will encourage the worker to develop and maintain day in and day out his full productive powers without injury to himself or fellow workmen. It should not be too high nor too low. If too low, the worker will not feel the additional recompense is worth the extra effort expended. If too high, the worker is likely to limit productions due to fear of possible rate cutting or to personal satisfaction with a certain wage.

If piece rates are correctly set and the plan is operated under proper working conditions, both workers and employer are benefited. The efficient worker justly receives more than his inefficient neighbor, reward being in proportion to skill and effort expended. The company gains, as increased effort on the part of the worker results in increased production with lower unit cost due to overhead being spread out over a greater number of units and almost always to lower direct labor costs as well.

> The average increase of total wage in a plant by incentive, above the time-rate market price of labor, will usually be at least twenty per cent. That is, as the worker's contribution to the net value of the total product increases, his share of production, expressed in the form of his total wage, can be, and in fact must be, increased accordingly. . . . Overhead expense, however, will constitute at least half of the total factory cost of the product; and this will remain nearly constant regardless of the volume of production, so that, with increased production, the overhead expense per unit of product will be decreased in the inverse ratio.[5]

When piece work fails it is ordinarily due to one or more of the following reasons:

1. *Incorrect setting of piece rates* due to improper incentive or to wrong standard rate of production set. Records based upon the opinion of the foreman as to what a worker should do or upon records of work under a day rate wage system are unreliable. The

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[4] L. V. Estes, Wages and Bonus Systems, The Engineering Magazine Company.
[5] George H. Shepard, The Economic Aspect of Wages, *Industrial Management,* November, 1927, p. 293.

first, at best, is merely a guess or an estimate; the second, is the record of what the workers did when there was no incentive offered. Rates based upon either source invariably are too high. The worker speeds up under the stimulus of piece work and may, as he often does under such conditions, double his former production. The employer resents the fact that in the past the worker has apparently been holding back output on him and he cuts the piece rate to bring the worker's earnings down where he, the employer, feels they should be. The worker resents this as he feels he should be permitted to earn all he can through his own efforts. He feels he has been tricked into showing what he could do. The result is broken confidence with the workers holding back on their jobs feeling that if they do turn out maximum output and so increase their earnings, their piece rate will again be cut with the result that their extra effort goes to naught as far as their pay envelope is concerned. When piece work fails due to the cutting of rates it is the fault of management who should have seen to it that the piece rates were set correctly and then should have guaranteed those rates. Another reason for the incorrect setting of piece work rates is the use of inexperienced men in time study work. This invariably results in inequality—the rate on certain jobs may be set too high so that the workers "kill the job" and earn big money while workers on other jobs, due to the fact that the rate is set too low, can barely earn day's wages even when exerting their utmost. Setting of piece rates requires experienced men and management is at fault if they do not employ such men.

2. *Workers sacrificing quality for quantity.* Adequate inspection should prevent such a condition. Speeding up production tends to detract from the quality of the work produced. If, however, the worker is taught the proper methods to use speed can be attained without sacrifice of quality. Inspection of all work with rejected pieces deducted from the number of pieces paid for tends to make the worker realize the importance of quality as well as quantity. Many different methods are used. Where quality is not so essential or where the operator is merely a machine attendant and as such has little to do with quality of output, it is frequently more practical to dispense with inspection and pay the worker for all work done. On the other hand, the quality limits may be very rigidly enforced as in the case of the Burroughs Adding Machine Company.

The quality is maintained by an extensive inspection division, where all parts below standard are rejected either for repairs or scrap. The operator who is personally responsible for rejects or scrap actually loses from his pay the cost of repairing rejected work, or, in case of scrap, labor paid on the part up to and including the operation on which he spoiled the work, plus the material cost. It will be seen, therefore, that, while the operator is encouraged to produce all possible, he is made personally responsible for the quality of his work through the only really effective means—a reduction in his earnings for work below standard.[6]

3. *No provision being made for recompense to workers* for such time as they are present and ready for work but cannot, due to conditions for which management is responsible. Poor material or lack of materials to work with, lack of power, a defective machine, tools in bad order—any of these conditions may prevent the employee from working and so deprive him of his earnings. A wage system to be truly effective should provide some adjustment to take care of conditions beyond the control of the worker. Such conditions, however, will occur only at rare intervals in a plant that is well organized and properly managed. With proper material and production control, adequate power and maintenance service, proper inspection and tool maintenance, materials will be up to specifications, machines will be maintained so that breakdowns are averted and power failure will be a rare occurrence.

Other Wage Systems.—As there are quite a large number of wage payment plans in successful operation, space does not permit of a detailed description of each. The salient points of some of the more common wage incentive plans will be given so that they can be compared in the light of their fitness to meet specific needs.

Halsey Premium Plan.—The Halsey premium plan provides a standard time for performing a given job with a definite per cent of all time saved given to the worker as a reward for completing the task in less time than the standard set. The hourly wage is guaranteed for all time put in irrespective of output. If the worker completes his task in less than the standard time he receives his hourly wage for each hour worked and, in addition, a definite proportion of the savings between the actual and standard in cost of direct labor.

[6] V. R. Becktel, *Management and Administration,* February, 1925, p. 137.

Thus, if a worker has an hourly rate of 50 cents per hour and the standard time for his task is ten hours, if he completes his task in six hours he receives $6 \times \$0.50 = \$3.00$, plus the proportion agreed upon, say 50%, which would be ½ of 4 hours or 2 hours at 50¢ = $1.00, total $4.00 for 6 hours or at the rate of 66 2/3¢ per hour for the time he worked.

The standard time set is based upon records of past performance. This has the advantage of making the plan an easy one to introduce as it involves no preliminary time and motion studies or changes in working conditions. At the same time it has the marked disadvantages that, having no thorough preliminary studies, adverse conditions are not brought to light and corrected nor do the standards set represent a carefully planned task, performed by all workers according to a standard method and under standard working conditions. The standard times set, therefore, do not give equal opportunity to all workers, as they vary according to the productive capacity of the workers whose past records were taken. Thus, some standard times are loose, permitting of easy jobs with big returns, while others are unjustly tight. This inequality is bound to result in dissatisfaction among those who do not receive the more lucrative jobs.

The Halsey premium plan is frequently used as a temporary expedient to increase production and interest the workers in wage incentive plans while the necessary studies and other preparations are being made to install another wage plan more fully suited to meet the particular needs.

Rowan Premium System.—The Rowan premium plan is similar to the Halsey plan in that it guarantees an hourly wage for all hours put in and that the standard time set is based upon records of past performance and not upon scientific study. It differs in that instead of giving the worker a fixed percentage of all time saved, it adds to his actual working time a percentage of his actual time equal to the percentage of reduction which the worker has made on the standard time. Thus, if ¼ of the standard time set is saved, time and ¼ is paid to the worker. For example, if a worker performs a task in six hours, the standard time being eight hours, he would receive in addition to pay for six hours the per cent computed by the fraction "time saved ÷ standard time" or $2/8 = 25\%$ of six hours which equals 1.5 hours. If the guaranteed hourly rate is 50 cents per hour he would

receive $7.5 \times \$0.50 = \$3.75$ for 6 hours, or at the rate of 62½¢ per hour.

Up until a certain point the premium under the Rowan plan is larger than under the Halsey plan, but after that point conditions are reversed. For example, if the percentage under the Halsey plan is 50%, the premiums are greater under the Rowan plan until 50% of time saved is reached, at 50% time saved the premiums under both plans will be equal and after 50% the Rowan premiums will be lower. For instance, at 50 cents per hour, standard time 10 hours, the premiums would be as follows:

Hours Saved	Halsey Plan	Rowan Plan
1	$0.25	$0.45
2	0.50	0.80
3	0.75	1.05
4	1.00	1.20
5	1.25	1.25
6	1.50	1.20

The Rowan plan is difficult to compute and costly to operate. The workers cannot readily understand it, so generally do not favor it. Its chief merit lies in its marked incentive to the worker in the first stages of saving and to the protection it gives the employer against excessive premiums due to standard times being too loosely set as the worker's earnings can never amount to twice the day rate.

Taylor Differential Piece Rate System.—The Taylor differential piece rate plan provides for standards scientifically set. In order to furnish a strong incentive to the ambitious and skilful worker a high piece rate is set to be paid to the workers who achieve an output equal to or greater than the standard. Similarly, inefficient workers are penalized by being paid a lower piece rate when their output falls below the standard. For example, if the standard set is 20 pieces a day, the high piece rate for those finishing 20 pieces or over might be 30 cents a piece, while for those finishing less than 20 pieces the rate might be 20 cents a piece.

The objections to the Taylor plan on the part of the workman are:

1. It does not guarantee a day wage.
2. It is too severe on the slow worker and the beginner.

Gantt Task and Bonus Plan.—Under this plan the workman is guaranteed a minimum day rate even if he fails to accomplish

the task set. If he meets or exceeds the task he is given his hourly rate for the time allowed for a task plus a fixed percentage of that time as bonus. The bonus may be anywhere from 20% to 50% of standard time, depending upon the nature of the work and the amount of incentive required to insure best efforts on the part of the workers. For example, in a case where the day rate is 50 cents per hour, with standard time set for the task at six hours and the bonus at 33 1/3% of the standard, if the worker completes the task in seven hours he receives 7 × \$0.50 = \$3.50. If he completes the task in four hours he receives 6 × \$0.50 plus (33 1/3% × 6 × \$0.50) = \$3.00 plus \$1.00 = \$4.00 for four hours work or at the rate of \$1.00 per hour. Thus, if the task set has been to turn out 40 pieces the worker gets 10 cents per piece. Similarly, if he completes the task in five hours he gets \$4.00 for the task, or 80 cents per hour, but the rate per piece is still 10 cents.

The Gantt system, therefore, is equivalent to a day rate for the unskilled workman and a piece rate for the skilled workman. The incentive provided is sufficient to make the average worker exert himself so that he ordinarily meets or betters the task time set. The Gantt plan as originally introduced provided for the determining of the task time by time study. In practice, however, task times are frequently based upon records of past performance.

Perhaps the main disadvantage of the Gantt plan is that a workman may work at maximum pressure on one job and receive an unusually high wage and then on a more difficult job or a job less to his liking take it very easy, knowing that his day wage is guaranteed irrespective of output.

Mr. Gantt advocates giving the foreman in charge of the workers a bonus in proportion to the number of men under him earning a bonus. This plan serves as an incentive to the foreman to instruct his workers as to the best method of doing a job and to do everything in his power to facilitate ease and speed of operation.

Emerson Bonus System.—Under the Emerson bonus system a day rate is guaranteed with a bonus on a graduated scale paid according to production efficiency. The salient points of the plan are:

1. Day rate guaranteed.
2. The standard times allowed are determined after a careful

time and motion study of the operations under actual production conditions.

3. A bonus is paid after 66 2/3% of the standard has been attained. This tends to serve as an encouragement to those who try but are not able to reach the standard. The bonus increases gradually from ¼% bonus at 67% efficiency to 20% bonus when the standard time is reached.

4. The worker is paid for the actual time spent on the task plus his bonus percentage of that time. If the worker does better than the standard set he receives in addition the difference between the actual working hours and the standard set multiplied by his wage rate per hour.

5. The worker's bonus is calculated for a pay period and not for each separate job. His efficiency is determined by dividing the sum of standard times by the sum of actual times. This reduces the cost of computing the payroll and makes the per cent efficiency shown truly representative of the effort of the worker.

Group Wage Payment Plans.—Workers almost invariably prefer that wages and any bonus paid be determined by individual effort. There are instances, however, of related jobs in which teamwork is fostered, production increased, earnings per employee raised, and costs lowered by the use of a suitable group payment plan. Ordinarily under individual incentive plans each worker strives to increase his own output regardless of the effect of his efforts upon his fellow workers or plant production as a whole. He feels that to stop his work to help a fellow worker lift a heavy casting or to give him a hand in any way is taking money from his pay envelope as he is paid only for what he himself produces. He may give the help needed but only from a sense of decency and of helping his fellow worker and not as a part of his job. With the group payment the workers know that it is to their advantage to help one another, as the greater the output of the group the larger the earnings of each individual in the group.

Under a group wage payment system the group may consist of merely a number of workers, doing the same class of work or related work, who pool their output and have their earnings distributed among the members of the group or it may consist of a number of such workers under a group leader.

The advantages of a suitable group wage payment plan under proper conditions are many and varied. Several of the more marked advantages will be discussed briefly:

Fosters Teamwork.—The attitude of "each man for himself" which is frequently found under individual systems is not conducive to pleasant working conditions nor to a proper spirit of friendliness among the men. Rapid workers are regarded as turning out too much work and of trying to show up the other workers in an undesirable light. On the other hand, the slow worker or the less self-assertive type may be imposed upon and frequently bullied. He is made to wait at the emery wheel, is crowded out at the toolroom window and in general made to step aside and let the other workers take all advantages. The new man who needs a little assistance until he gets familiar with his work or the worker who needs a hand on a hard job is left to shift for himself or to wait another worker's convenience. Under the group system there is an incentive to help one another and to encourage the new worker and instruct him so that he may increase his output. The rapid worker is looked upon in a new light, the group is pleased to have him as one of the group. The slow worker with the rapid worker as an example before him strives to come up to his record and a friendly rivalry is encouraged.

Less Supervision Is Required.—The foreman instructs the group leader who, in turn, gives the necessary instruction to the workers in the group. The group leader is told what jobs are to be done and their order. It is then the duty of the group leader to assign the jobs to the individual workers. The leader, sharing in the earnings of the group has an incentive to see that the jobs are correctly assigned, that the men are provided promptly with the required materials, tools and drawings and that they follow the correct methods. With the group leader exercising supervision over the group, the foreman is relieved of much of his supervisory work as it is easier to supervise the smaller number of group leaders than it would be to supervise all of the men in the groups. This permits of a reduction in the supervisory force and a consequent reduction in costs. The group leader while in a supervisory capacity must be classed as a production employee as he does actual production work as a member of the group.

Simplifies Accounting.—Under individual incentive plans it is necessary to keep track of the output of each individual. A time slip or job ticket is turned in on each job worked and the amount earned figured for each slip. The amount earned by the worker in a given pay period is the total of earnings shown on all slips turned in during that period. Under a group system wages are much more simple to compute, as it is only necessary to keep track of the output of the group in a given pay period and the total time spent by each worker in that group during that period. Mr. R. S. Perry,[7] Planning Manager of the Hudson Motor Car Co., which pays its men by a group system states:

> Our men are assured of a certain day's pay calculated on an hourly rate and in addition a bonus made up from a calculation of the number of pieces produced.
>
> This system is very easy to compute because all payment of the piece work portion of the plan is made from the number of large units produced. For example, the men in our axle plant are paid their regular daily rate plus a certain bonus, depending upon the number of completed axles produced. No attempt is made to count individual pieces from any particular operation. Our payment standards are based upon time studies of operation. The unit cost is therefore predetermined. Deviations from these standards are reported when gangs fail, on a production basis, to earn their guaranteed day rates.

Costs are more accurately determined and at much less cost to keep track of and compute under the group system. Under individual wage payment plans record must be kept of the time of each man who works on a job and that time multiplied by his wage payment rate. The sum of the labor costs of all workers on a job equals the total labor cost of that job. The total labor cost of all jobs required to complete a unit is the labor cost of that unit. Under the group system, labor costs are not figured by the job but by the product of the group. By multiplying the time required to complete a unit by the wage rate of the group producing it the labor cost of the unit is very readily determined. Thus, if it takes a group four hours to complete a unit and the wage rate of the group is $4.50 per hour, the labor cost of the unit is $18.00.

Increases Earnings.—Under a good leader the members of a group exert their best efforts and working together they each accom-

[7] Methods of Compensation No. 3, Metropolitan Life Insurance Company, New York.

plish more and earn more than they probably would individually. Poor workmen, lazy fellows or those not suited for the job soon have it pointed out to them by their fellow workers that they are not wanted in the group, and that they must either do their share or get out and make room for workers who will.

Increases Production.—The incentive of greater earnings under the group wage payment system, the spirit of teamwork prevailing, and the minimum of red tape, all tend materially to increase production.

Certain disadvantages of the group wage system are sometimes cited. In some cases it is said to tend to destroy individual initiative. This may be due to the grouping of operators whose work is unrelated or whose capacity for work varies to a marked extent. The group wage payment system is not the proper wage system to use under such conditions. Neither should the system be used when difficulties due to racial differences or to peculiar characteristics of certain nationalities are likely to be encountered.

CHAPTER XXXI

THE FOREMAN AND HIS JOB

Place of the Foreman in Modern Organization.—The foreman is frequently spoken of as the "key man" of industry. There is perhaps no better way of expressing the vital importance of the job of the foreman. The maintenance of a stable, efficient working force is prerequisite to success in business. The foreman more than any other one man in modern organization holds this responsibility, as he is the point of contact between the management and the workers and represents the management to the workers. Competent, fair-minded foremen promote smooth running of the business and success. Improper handling of workers by incompetent foremen breeds dissatisfaction and ultimately serious labor troubles.

The foreman of the past hired his own workers, planned the division of work, gave the necessary orders, inspected the work in process and the finished product, cared for the equipment, figured costs and did a thousand and one things that no one individual could possibly do and do well. He became a harassed, overburdened individual, hustling all day long from one odd job to another. He drove himself and, in turn, became a driver of his men, not a leader, one who had lost the true prospective of his job and used his hands instead of his head.

Modern management, recognizing the importance of the job of foreman and the futility of expecting any one man to be able to perform efficiently all the duties of old time foremanship, has taken away many duties and placed them in the charge of specialists. As we have seen in Chapter XXI, the responsibility for repair and maintenance of equipment is no longer placed on the foreman but on the maintenance division, which division is responsible for maintaining equipment in first-class operating condition at all times and of so arranging its schedule of work as to reduce to a minimum any interference with the production schedule. Likewise, there may be specialists in charge of employment, others in charge of planning, of inspection, of tool control, and so on. The foreman of today is

responsible for the general conduct of his section in accordance with the policies of the company and for the output of his workers in regard to quality, quantity and economy in the use of materials. To this end he must recognize and appreciate the ability and possibilities of his workers and so direct them and coordinate their efforts with the work of the supporting specialists that maximum output is obtained with the least expenditure of time, effort and money.

Duties of the Foreman.—The duties assigned to an individual foreman depend upon local conditions and the degree to which specialization has been carried in the particular concern. In a small concern, where there are comparatively few workers in a section, the foreman in charge would ordinarily do certain production work in addition to his main function of direction and control of his section.

In a large concern many matters pertaining to the work of a section would be handled by specialists and, theoretically, the foreman would thus be relieved of all responsibility concerning them, but in reality it is decidedly to the advantage of the foreman to understand the work of the specialists and to cooperate closely with them, as frequently the degree of success attained by a section depends to a considerable extent upon the care with which the specialists perform their duties. The foreman, therefore, has certain duties for which he alone is responsible and other duties the responsibility for which he must rightly share with others. Among the more important duties of the foreman are the following:

1. *Plan and organize his work and the work of his men.* Even where a production control division plans the sequence of operations and an employment division supplies the men, the foreman from his daily contact and intimate knowledge of each workman and each job can allot duties so as to get the highest possible returns from machines and men.

The foreman who studies his men knows that no two of them are alike. He knows that John Brown is willing and dependable but that he is naturally slow and should not therefore be put on any job which calls for quick movements. He knows that Frank Smith is exceedingly anxious to do everything that is asked of him, but if he is put on a rush job he simply "goes all to pieces." He knows that certain others of his men need the spur of competition to make them exert their best efforts. By studying his men and by changing

their tasks he knows just what each man can do and how it is best to handle each one. One man he knows he can only handle through praise. A word of praise and he exerts his utmost, a word of censure and his spirit wilts. Another man working at the machine alongside of him has to be handled quite differently, as he is of the type who quickly gets a "swelled head" if praised. The true foreman knows each man under him.

To prepare against emergencies and to make the operation of his shop as flexible as possible, the foreman should avoid one-man jobs when possible. By training his men so that each man can handle at least two different jobs the wise foreman prepares against emergencies. If, for some reason or another, a workman in charge of an important operation cannot come to work, the foreman has another man whom he can immediately put on that operation and so eliminates the possibility of holding up production.

The foreman should always plan his work so that there is at least one job ahead of each workman in addition to the job upon which he is working. A fruitful source of waste and one found, at least to some extent, in the majority of shops is idle labor and idle machines due to lack of proper planning of work. The worker who knows that there is another job waiting for him when the present one is finished feels no necessity for false motions to make the job last and to give an appearance of being busy. Many a worker purposely takes twice as long to do a job as he should, fearing that if he works right along the supply of work will run out and he will lose his job. The foreman who is worthy of his name plans the work of his shop in advance and sees to it that the necessary materials, tools and information are all available to the workers beforehand so that jobs may be started in time to meet the schedule of work planned.

2. *Maintain a proper labor supply.* The foreman should strive to maintain the minimum working force that will efficiently take care of the work to be done. This necessitates that he make prompt and explicit requisitions to the employment department for new employees and that he give the final approval after selection has been made.

The foreman should know the ability and productive capacity of each of the men under him. With this information he can then determine the number of men required to produce a given number of units. If production is to be increased he can figure quite closely just how many more workers he needs. If production is to be curtailed

and he must let some of his men go, he knows not only how many men must be laid off but just which men. In this way he retains the workers whose services are of most value to the company.

The foreman's duty in regard to the maintenance of a proper labor supply further necessitates that at the first sign of dissatisfaction among the workers he seek out the cause and remove it or remedy the adverse condition.

3. *Direct, instruct and guide the workers.* The foreman should see that every new man gets started right. There is always one best way of doing a job. The foreman should show the worker the correct method, operation by operation, and then follow up the work to see that he keeps to that method. A friendly and sincere foreman who shows a willingness to cooperate with his men will promote like feelings in his workers and will ordinarily experience little or no difficulty in directing and controlling them.

The foreman should see to it that the work and methods in his shop are standardized as far as practical working conditions permit and that the workers understand and follow the standard practice. Likewise, he should instruct the men in the oiling and general care of their machines so as to reduce maintenance expense and to avert breakdowns.

At this point it is well to emphasize one of the failings common to many foremen. It is the duty of the foreman to delegate work to others and then to supervise that work to see that it is properly done. Many a foreman loads himself down with work which it is not his duty to do. When a foreman does the actual work on a job he is not only doing the work that the workman should do and so interfering with the development of the worker, but he is doing what is a more serious mistake in so far as the operation of his shop as a whole is concerned. All the time he devotes to doing the actual work on a job is just that much time which he is taking away from the performance of his real function, namely, the direction, supervision and control of his shop. A man of less ability and earning a lower wage can do the work on a job, can get the tools required for a job, etc. The foreman's duty is to instruct and guide the worker but not to do the actual work.

4. *Keep up the morale in his section.* The morale of a section can only be maintained when the workers have absolute faith in the integrity of their company and their foreman. Strict discipline, sin-

cerity and squareness of action, frank and open consideration of all complaints and grievances are essential qualifications of the foreman who gains and holds the respect of his workers. Promotion of those deserving, absolute lack of favoritism, fair and square dealings in regard to wages, hours of work and working conditions are some of the things that help to build up and maintain morale in an organization.

The foreman who gives praise for a job well done, who is impartial in the distribution of jobs so that no one man gets an unfair percentage of the less desirable or the more desirable jobs, who permits of no inequalities of pay in his shop and who voluntarily recommends a raise in wages when a raise is deserved, instead of waiting for the workmen to ask for it builds up a spirit of loyalty and interest in the work.

In building up the morale of his shop there are two points which are essential for the foreman to bear in mind: first, the necessity of always obeying orders himself and second, the training of understudies. If the foreman violates a rule he not only sets a bad example but he minimizes the effect of the rule he has broken and of subsequent orders as well. The foreman who comes in late is hardly in a position to reprimand the worker who does the same thing. Likewise, in regard to rules for safety. If, for example, there is a rule that goggles must be worn when engaged on certain jobs and the foreman himself disregards that rule when he is instructing a worker on one of those jobs, the foreman by his example is teaching disrespect for orders and, in addition, is failing in his duty in regard to the safeguarding of the men placed in his charge.

Getting the work out is the first duty of the foreman and second to that is the training and development of his men. The foreman who has his shop well organized has trained understudies for his own position and for each of the more important jobs in the shop. If, for any reason, he must be absent from his shop the work goes along as smoothly as if he were there. Such training of understudies cannot be accomplished over night. The first step is carefully to select the assistants; second, to give them definite instructions; and third, to assign to them certain duties and to give them sufficient freedom of action to show their initiative. As the understudy develops self-reliance and ability little by little, more responsibilities can be added. In a shop where understudies are trained,

in case of a vacancy, there is always someone who can be promoted to fill the vacancy. Promotion from the ranks rather than bringing in someone from outside is one of the most effective ways of building plant morale.

5. *Supervise work in process.* This covers watching of work in process to determine quality, supervision of the mechanical processes to eliminate waste and inefficiency, study of the capacity of machines and the flow of work to permit of accurate scheduling and of prompt conveyance of materials from operation to operation.

A knowledge of just how much supervision is required under given conditions is something which comes only after study and experience. Too much supervision defeats its own purpose as it consumes the time of the foreman and takes away the initiative of the worker. Too little supervision permits the workers to grow lazy and careless and results in increased spoilage and decreased production.

6. *See that materials, machines and equipment are kept up to standard.* While the inspection division is responsible for seeing that materials are up to standard and the maintenance division is responsible for seeing that machines and equipment are kept in good working condition, the foreman is equally interested in questions of inspection and maintenance in so far as they relate to the work of his shop. For example, assume that in a machine shop work is being done on steel forgings which should be of a certain degree of hardness. Difficulties are encountered, feeds and speeds have to be slowed down with the resultant decrease in output. The inspection department has passed the forgings as O.K. after presumably giving them the Brinnell test for hardness. This, however, does not eliminate the possibility of a wrong degree of hardness. The foreman knows that everyone makes a slip at one time or another so he requests that an immediate test for hardness be made on samples taken at random from the lot. Similarly, with questions of maintenance of machines and equipment. The maintenance division may be responsible for keeping the machines in good working order but that does not help the production record of the shop or furnish jobs for the men in case production is held up due to breakdown of an important machine. The foreman should see to it that machines and equipment are properly used and cared for and that inspections are made regularly so that breakdowns and unnecessary wear may be

avoided. In this he works in cooperation with the maintenance division.

7. Keep certain records for managerial control purposes. The number and kind of records necessary would depend upon conditions in the particular plant. The rule is to keep only such records as are essential. An absence of records means decisions based on guesswork. Too many records means turning the foreman into a clerk.

The foreman should appreciate the value of well-kept records in the control of his shop and the necessity of keeping his records up-to-date so as to be able to make practical use of them.

8. Cooperate with and correlate the work of his section with that of other sections and divisions. While service divisions take many of the old line duties away from the foreman, it is his duty to keep himself informed at all times of the services rendered by them to his shop. In this way, if a service falls down he is immediately cognizant of that fact so that he can check or counteract any error before damage is done. Even a small failure, if allowed to go unchecked, reduces the general efficiency of the shop. The failure to deliver a seemingly unimportant material may hold up production; and similarly, delivery of material not of the proper quality may result in the operator's not being able to finish his task in the allotted time or in turning out a product which does not pass inspection. The foreman can obtain full benefit of the services supplied him only when he cooperates fully with the service divisions and does his part in correlating the work of his shop with that of the service divisions. If he is familiar with the material control system and cooperates closely with those in charge of it, likewise with those in charge of inspection, of maintenance and of production control, the operation of his shop will be greatly facilitated.

For example, the inspection division is responsible for seeing that the product turned out is up to the standard of quality that has been set. The foreman is responsible for the quantity and quality of the work done in his shop. If the quantity falls short or the quality is below standard, he is responsible. The inspection division checks quality for him and points out to him upon what operations it has fallen below, but it is up to the foreman to remedy the adverse condition and to see to it that quality standards are maintained. Close

cooperation and correlation of work between the foreman and the inspection division is therefore essential.

Similarly, the foreman should work in cooperation with the engineering department. If a design is unsatisfactory from a manufacturing standpoint, the engineering department should be immediately notified of that fact, the reasons given and, if possible, suggestions offered as to how the difficulty might be gotten around so as to meet the needs of the shop. The foremen, due to their daily experiences in the shop, can offer valuable suggestions as to design and methods of work. For example, in the average shop a lot of time is wasted due to the fact that jigs and fixtures are not properly designed. A wing nut may be used requiring several turns in order to tighten or loosen the fixture every time the material or part is inserted or removed, whereas an eccentric would serve the purpose equally well and would only require throwing of a lever, the work of an instant. It is such small, unnecessary wastes of time which prove costly in production. Close cooperation between the foremen and those in the engineering department and the tool and equipment section will invariably prove of advantage to both sides and result in improvement of the product and lower manufacturing costs.

The above holds equally true in regard to the relations of the foreman with the time study man. The foreman should work with the time study man, giving him sincere cooperation rather than placing obstacles in his way as some shortsighted foremen are inclined to do. All the services supplied to the foreman are for the good of his shop as well as for the good of the company as a whole. They are to relieve the foreman and to help him to increase production. An intelligent use of them and correlation of the work of the shop with the work of these service divisions should be the aim of every foreman.

A further duty of the foreman and one which should not be neglected is to cooperate with the foremen in the other operating sections, especially with those with which his shop is closely related. A foreman may be very efficient in his own shop but he fails in his duty as a foreman if he obtains his results at the expense of other shops. It is only natural that a foreman should consider all matters in the light of the effect upon his shop, but he must never allow his concern for his shop to interfere with the welfare of the company as a whole. A friendly rivalry between shops is a healthy condition but jealousy or selfishness has no place in any shop, as they invar-

iably result in interference with the good of the company as a whole. The true foreman cooperates with the foremen of the other shops and works with the best interests of the company as a whole paramount at all times.

9. *Represent the management to the workers and the workers to the management.* The foreman, being the point of contact between management and workers, should interpret management policies to the men in such a light that there will be no possibility of misunderstanding. In the same way he should present the opinions of the workers to the management. Mutual understanding breeds industrial goodwill and is an able safeguard against seditious propaganda.

If the foreman is the right sort of foreman, his men have confidence in him and will listen to him and believe in him if he explains the reasons back of certain actions of the management which the men have misconstrued or do not understand. Thus, if a new system of wage payment is being adopted, the foreman should see to it that his men understand the notices that are sent out announcing the change in method of wage payment. He should explain to them the reasons for the change and what it is hoped to accomplish by the change. Similarly, if the article produced is one in the manufacture of which there is keen competition, the foreman should explain to the men the need for keeping manufacturing costs at a minimum and the necessity of eliminating waste and increasing production if the men are to earn a good wage and the company to prosper.

10. *Keep down the costs of his section.* The foreman should be supplied each month with a simple yet comprehensive statement of the burden of his section for the past month, the form being such that he can make ready comparison with the costs of previous months. Proper attention on the part of the foreman to expenditures for the numerous small units that go to make up the burden account will in many cases decrease the burden account to an extent that is astonishing. The ordinary foreman is not willfully careless of costs but he simply does not realize the many little costs which enter into his burden and their sum total.

The foreman should also be given accurate cost figures for direct labor and material so that he can realize true costs and eliminate, as far as possible, excess costs due to idleness, slowness and general inefficiency on the part of the workers, and wastage and improper use of materials, tools and supplies. Frequently, a foreman will find

that the high cost of labor and materials in his shop is due to his own lack of planning and of proper instruction and supervision. He may find that he is using high grade labor on jobs that could be handled equally well by men getting a lower wage and that one of the workers can readily handle much of the work he himself is doing, thus leaving him free to instruct his workers in proper methods and to supervise their work to see if they are following these methods. As an incentive for cost reduction frequently a budget allowance is made for each shop and the foremen given a bonus on all amounts saved, the bonus being in proportion to the efficiency of the shop.

Qualifications Necessary.—A foreman must have a thorough knowledge of the processes and operations to be carried on in his shop in order that he may be able to instruct, direct and control his workers intelligently. This does not mean that the "top notch" operator in a shop should be chosen foreman. Other qualifications enter into the question of the man to be selected. The man qualified to be foreman understands methods and operations thoroughly. He knows "what" to do, "when" and "how" to do it and, what is equally important, he knows "why" it should be done in that way. He can therefore explain the "why" and "wherefores" of the job to the worker. The worker so instructed works more intelligently and turns out more and better work than the worker who merely follows orders blindly.

The foreman must have initiative, for without it neither he nor his shop can progress. He must not, however, be a driver. Men can be led farther than they can be driven. He must, therefore, be a leader. Industry no longer has a place for the driver. It does not want the foreman who "takes the roof off" when a mistake occurs, who swears and shouts at the one at fault and calls him down in a voice that all the shop can hear. Such a foreman only holds the timid worker who is afraid to change his job and the indolent worker who, even though he is discontent in his job, is too lazy to seek another. The quality of leadership is essential to successful foremanship.

As a leader of his men the foreman sets the example for his men. He should, therefore, be industrious, fair and square in his actions, friendly, reasonable and willing to cooperate at all times. He should make no promises which he cannot carry out. He should be cor-

dial but not to the point of familiarity. He should call each man by name and be democratic but he should never be "one of the boys." To hold the respect of his men and to keep up the morale of his shop he must maintain strict discipline, be consistent in all his actions, be impartial in his judgments and so conduct his shop that he becomes known as "a good boss to work for."

Necessity for Foreman Training.—From the foregoing discussion of the duties and qualifications of the foreman, it is at once apparent that the foreman just promoted from the ranks is rarely properly qualified to assume his duties and responsibilities. In his old job it was his duty to do the actual work on a job, now it is his duty to see that the work is properly done by others. Before he followed instructions, now he gives instructions. Formerly his work was largely planned for him, now he plans for others. The foreman may be familiar with the routine of the shop, but his position requires more than that. He may know the standard course of procedure to follow in the performance of a certain duty, but no routine, no matter how well developed, can provide instructions as to what to do under every condition. The foreman needs to know the reasons why certain matters are cared for in a certain way, then he can act intelligently and make a proper decision in time of emergency. In other words, when a man has become a foreman he has graduated from the stage where he played the part of follower. He is now leader and he must be able to size up conditions and to think for himself. This requires knowledge and experience which he does not have. However, as he has had sufficient initiative to break away from the ranks, he will invariably develop if given sufficient encouragement and opportunity for learning. This can be supplied either by establishing training groups under competent instructors within the plant or by having the foremen enroll at established institutes of learning offering foremanship courses. Either plan, if properly carried out, can be made successful. The first plan has the advantage that discussion can be made to relate to the specific problems of the particular plant. The plan will fail, however, unless competent instructors can be found. This is not always an easy matter, as many executives know their own subject well but do not have their knowledge logically organized nor can they present it effectively.

A discussion of methods of foreman training was covered in

Chapter XIX. A review of the subject matter covered in that chapter is advisable here. It should be borne in mind, however, that, regardless of the method of instruction, the aim is always the same, that of broadening the viewpoint of the foreman and of developing in him the quality of leadership and the art of handling men.

CHAPTER XXXII

BUDGETS

Necessity for Budgetary Control.—To control any enterprise careful plans must be laid for the future and those in charge held strictly accountable for the carrying out of those plans. This planning and controlling of future activities is the basic principle of budgetary procedure. Under a proper system of budgetary control budgets are drawn up based upon facts and figures as brought out in a careful analysis of all relating conditions. This gives executives a basis for decisions and actions, serves to eliminate snap judgment and to provide the means of recognizing adverse conditions so that they can be prevented or counteracted before it is too late.

It is almost universally recognized that a budget plan properly developed and administered will prove effective for the company manufacturing a standard product of only a few types and sizes. It is not so generally recognized, however, that the budget idea can be applied to advantage when manufacturing a variety of products even when the number of products may run up into the hundreds and the design of the products may have to be changed rather frequently to meet competition and changes in public taste and demands. True, a formal budget plan such as will apply in the first instance may not apply in the second. The budget idea, however, which after all is nothing more than planning in a definite and orderly way, can be applied in every business regardless of its type and whether large or small.

The managements of many of the smaller concerns do not see the necessity for budgeting their business. From lack of understanding they believe that budgeting their business would entail a multiplication of forms and red tape and considerable expense and that, their business being small and control closer, they do not need the aid in management that budgets may give. This conception shows a lack of knowledge and appreciation of what budgeting a business is and does. A set of forms is not the all-important part of budgeting, impressive as they may look to the novice in budget mak-

ing. In many concerns few forms would be required beyond those already in use. As to the value of budgeting—budgeting necessitates study of what has been done, what is being done, what is to be done and the formulation of plans with provision for carrying them out. Such study reveals weak places and points out danger spots to be avoided. In a large concern an error in judgment or a loss due to being caught unprepared, while unfortunate, ordinarily does not have the serious consequences that a similar instance would have for a small concern with less resources. It follows, therefore, that the small concern should plan even more carefully than the larger concern and that budgeting for them is not only desirable but essential.

Budgets Defined.—A budget may be defined as a collection of estimates of income and outgo for a coming period based upon records of past experience, present business conditions and future trends. Budgets are not restricted to dealing solely with dollars and cents. The budgets necessary for the adequate control of a business give estimates of the probable accomplishments of every department as well as the probable cost of running the departments.

Essentials of Budgetary Control.—In our discussion of budgets and of the procedure involved in budgeting a business we will assume that the company is correctly organized and that the accounts are properly set up, so as to segregate departmental results and to permit of periodical comparisons. If a company is poorly organized with authority overlapping and responsibility not clean-cut, the faults in organization should be corrected before any attempt is made to budget the business, otherwise the budget plan will fail in all probability. Similarly, as budgets should be built up in the same terms as the regular system of accounts in use, the installation of a budget plan should be postponed until any necessary changes in the accounts are made if it is found that the accounts have not been so set up as to segregate expenditures along departmental lines and to permit of the necessary periodical comparisons. When budgeting fails or involves excessive costs it is almost invariably due to faults in organization or related procedure which were present but unrecognized as such when the budget plan was inaugurated.

The essentials in budgetary control may be expressed briefly in the three following steps:

1. Statement of plans of each department for a given budget period, giving estimates of probable accomplishments and expenditures.

2. Coordination of department estimates and any necessary changes made, so as to develop a well-balanced program under which the company can operate as a unit. Upon approval by the designated authority the budget program becomes effective on the date set.

3. Check of actual performance against estimates to see whether each unit of the business is living up to the estimated accomplishments and within its estimated expenditures. These comparative reports permit of proper control and of revision of the budget program where necessary.

Procedure in Installing a Budget Plan.—If a formal budget plan is drawn up and dictatorially presented to those in the organization who are to be called upon to live up to it, they will resent it very naturally. If, however, these same executives are taken into the confidence of the management, educated in the value of budgeting and in the fact that it will make their work easier for them, and then they are given a part in the development of the budget plan they will almost invariably become enthusiastic in their support. The first step, then, in installing a system of budgetary control is to win the cooperation of the personnel of the organization. Frequently, department heads oppose the installation through lack of understanding of the advantages to be derived and through the fear that it will deprive them of their customary freedom of action. A little time and effort spent in "selling the idea" and in winning wholehearted cooperation will be more than repaid in the results accomplished, while the forcing of a system into the organization will only result in endless friction and halfhearted cooperation. A system of budgetary control rightly installed and properly operated will do much in fostering a spirit of teamwork which is of vital importance in any business.

Extent of Budgeting.—The second step is to determine the extent to which budgeting should be carried. A common mistake is to attempt to put in a complete system of budgetary control at the very start. As one executive very aptly expressed it, such a course is likely to result in "mental indigestion." A much safer and more conservative way is to start with some one phase of the business and budget it, as, for example, the budgeting of sales. When this is

working smoothly, then budget another phase of activity, and so on. In this way, a well-developed budget plan will gradually evolve, and the budgeting of each additional phase will involve less experimenting as profit is made by previous mistakes.

The kind of business and the particular conditions surrounding the individual concern will determine the extent to which budgeting can ultimately be carried profitably. Every concern can and should use budgeting to a certain extent, while many concerns can use to advantage a complete system of budgetary control.

Length of Budget Period.—The next step is to determine the proper length of the budget period. This varies with the individual concern and depends upon the length of time for which accurate planning can be done in that particular business. Among the influencing factors are the nature of the business, the rate of turnover, market conditions, financial conditions and the method of financing, the length of the production and accounting periods, the accuracy and extent of records of previous years.

Many concerns set up an annual estimate broken down into months, others budget on a six-months basis, others on a quarterly or on a monthly basis and some few on a two-weeks period. One of our largest manufacturing concerns plans four years ahead, revising their estimate monthly in the light of conditions which develop during that time. It can be readily seen, however, that for many concerns it would be impractical to extend their estimate very far in detail for that length of time, or even for a full year. Armour and Company of Chicago [1] had their budgets on a six-months basis but changed it to the quarterly basis and have found that they can judge very accurately for a quarter. Some concerns have found the thirteen-period year of distinct advantage to them for budgeting. The Fuller Brush Company has used it successfully since 1924.

Preparation of Budgets.—The next step is the actual making up of budgets and the adoption and putting into effect of the budget program as decided upon. This may be taken care of in a variety of ways. When budgets first began to be used to any extent in industry, the general practice was to have the budgets prepared by the higher executives and transmitted to the department heads with in-

[1] W. S. Clithero, Director of Budgets, Armour and Company, Annual Convention of the American Management Association, 1928.

structions to carry them out. This method did not work out very well for two reasons. First, department heads as a whole are of a calibre of men above the average and they very naturally resent orders being given to them in an arbitrary manner. They reason if they are capable of filling their position as department heads they are worthy of taking a part in deciding the possibilities of their departments. The second reason is equally far-reaching in effect. When a department head is asked to cooperate in drawing up a budget he sets a goal for his department and he will bend every effort to live up to the estimates he has set. When the estimate is prepared for him he has not set a goal, therefore he has not the incentive to live up to the figure set. When he sets the estimate he is stating what he confidently expects his department can perform, and no man likes to back down on what he has said. That would be admitting his department is not as efficient as he has said it was. When the estimate is set for him he usually resents the fact that he is being dictated to and he insists that the goal is set too high and that it is impossible of accomplishment. Only under pressure will he do his utmost to meet the figure set, even though it may be lower than he personally would have set it if he had participated in drawing up the budget. In imposing a budget on the department head the all-essential spirit of teamwork is lost.

Some concerns swing to the other end of the pendulum and have budgets prepared by those who are to use them, without their having sufficient aid and guidance from those higher executives who have a broader conception of the needs of the company as a whole. This method falls short of success, as those preparing the budgets do not have the background of information needed. They are not familiar enough with general company policies and plans and the needs and plans of other departments. The common sense method and the one that is now generally used is the preparation of budgets through cooperation of those who are to use them and the coordinating executives.

The Budget Conference.—Frequently, a conference is held of the major executives and department heads at which meeting are discussed the general plans for the coming period. Changes in company policy and important departmental changes which have a direct bearing on other departments are brought up for considera-

tion. It may be that business is falling off over the country in general and that in consequence the company is going to adopt a very conservative policy until business begins to recover. Again, it may be that a more liberal advertising policy is to be followed or that advertising is to be concentrated on certain products. Any changes such as a decided change in design of a product or the addition of a new product to the standard line, should be brought out. The fact that a system of production control is to be installed with the aim of reducing costs and maintaining a more balanced production might materially influence other budgets besides that of production. Discussion may bring out the fact that the sales department has not been able to secure the amount of orders they should due to competition, a competitor's product being 10% lower in price. In the light of the expected improvements in production, it may be considered advisable to reduce the selling price so as to meet the competitor's price, it being expected that the changes in production methods and the estimated increased volume in sales will permit of more efficient production and lower unit costs. Similarly, with numerous other contemplated changes in policy and new plans. A change in collection policy would appear on the surface to affect the financial condition and probably sales, but little else. A moment's consideration, however, will show that the effect might be far-reaching and affect directly or indirectly all departments.

After the meeting or the several meetings as will very probably be required, with the program as outlined in mind, the sales manager prepares an estimate of sales for the coming period. The heads of other departments then prepare their estimates in logical order. The various budgets are submitted to the committee or executive in charge of the budget program. These preliminary reports are usually accompanied by a written statement explaining any important differences between the figures on this budget and the budget of the preceding period. The budget committee or the executive in charge of the budget program who may be the comptroller, general manager or one of his assistants or any other executive of the company chosen for that purpose, then studies and compares the estimates submitted with a view to coordinating the estimates of the various departments. After a careful consideration of all estimates, they are returned to the respective department heads with any suggestions which may be desirable. The estimates are then revised by the department heads

and returned to the executive in charge of the budget program. If they are then satisfactory, they are approved and adopted.

Provision for Check of Estimates with Actual Results.—The final step is the check of actual results against estimates. It is not an uncommon occurrence for a company to set up a budget program and then leave it in the air without providing any means of enforcement. Provision should be made whereby department heads are provided with accurate reports showing the comparison between the estimates set for their department and the actual accomplishment and expenditures. Unless there is such a check there will not be the necessary feeling of individual responsibility on the part of those who are to carry out the budget. With the reports provided, however, the department head can accurately determine the efficiency of his department. If the report is in sufficient detail, with a little study he can place his finger on the weak spots and correct them, bringing pressure to bear, if necessary, on those responsible.

Comparison of estimate and actual performance should be made as frequently as conditions require. If the budget is broken down into monthly periods, as most budgets are, the comparisons are made promptly at the end of each monthly period. Where the comparison is unfavorable, the one in charge of the department in question is asked for an explanation. It may be that he has relaxed on his vigilance and that his payroll has grown too large, or his department has been wasteful in other ways—again, the poor showing may have been the result of things beyond his control. In the latter case, if the same adverse conditions are still present, the estimate for the next budget period may have to be revised. In the check of actual performance against estimates, the same persons who had a part in the making of the budget and passing upon it now consider the results shown. Cooperation and helpfulness are the aims, with pressure being brought to bear only when the desired results cannot be otherwise achieved. Here again is an illustration of the value of properly organized and well-conducted conferences. If comparisons are brought out in conference, the lagging department head seeing his fellow department heads meeting and surpassing their estimates, feels the reflection upon him and his department and resolves to show what he can do. His competitive instincts aroused, he frequently shows even better results than were thought possible of him.

Budgets Required.—Budgeting methods and procedure must be developed and operated to fit the needs peculiar to the individual concern. The nature of the business, company policies, the type of organization and the personalities of those who are to use the budgets all must be considered. As no two concerns are alike in these respects, it follows that there are no standard methods and procedures that can be followed in installing budgets. The budgeting idea and the basic principles are widely applicable; the particular methods and procedures to follow are an individual company matter. The following descriptions of some of the budgets required in an industrial plant and the illustrations given are merely suggestive. The intention is to give a general idea of the budgets required and to stress the need for considering the various budgets not only as independent units but as a part of the company budget as a whole. Just as the various departments are dependent for their operation upon related departments, so in the making of estimates, those compiling departmental budgets must use the estimates of related departments. Each budget, although given as a separate budget for the purpose of our discussion, is, after all, only a part of the general budget of the business in question.

Sales Budget.—As the income from sales provides the money for the running of the business and as sales requirements and expectations form the basis of the activities of the other departments of a business, the sales budget is ordinarily made first. In Chapter XXIV[2] it was brought out that planning for production requires as accurate an estimate of the sales requirements as is possible and that this is secured by means of the sales budget. The sales budget likewise permits of setting up an intelligent program of purchasing, reduces inventories of both raw materials and finished goods, makes it possible to a great extent to smooth out the peaks and valleys in production and tends to minimize costly fluctuations of employment which decrease efficiency and contentment of labor.

Analysis of Sales Field.—In order to prepare intelligently a sales budget it is necessary to make a thorough analysis of the sales field, to judge the capability of each salesman and set a qouta for him, to determine the possibilities of all present sales territories and

[2] It would be advisable at this point to review the discussion of market analysis in Chapter XII and of demand in Chapter XXIV.

the advisability of working them more thoroughly or of entering new fields, to consider the methods of distribution used and the success attained through them and to make decisions as to any changes necessary. After such an analysis based upon a study of present business conditions, future trends and past sales records, the sales budget is drawn up.

It apparently is the ambition of many sales managers to sell to the whole country. That is a very creditable ambition provided the profit on such widely distributed sales justifies the expense involved. It takes a concern with large resources and a product of wide demand to justify country-wide advertising and selling. Comparatively few concerns fall in this class. The very great majority of concerns would increase their profits if they would determine by a market analysis the trading areas most favorable for their product, limit their efforts to those areas and intensify their sales activities within those areas. The time of making up the budget is a good time for taking stock, as it were, of the sales situation and of the results that have been accomplished and are being accomplished under present methods. This is the time for laying plans to enter new territories, for reallotting present territories where necessary and for dropping those territories which are not profitable.

Distinction Between Sales Quota, Estimate and Budget.—In describing how to prepare a sales budget, the statement was made that it is necessary "to judge the capability of each salesman and set a quota for him." Before discussing this statement a distinction should be made between the words "quota," "sales estimate," and "sales budget," terms sometimes used more or less interchangeably. The sales quota is set up as a goal to stimulate sales effort. The sales estimate is the amount that it is expected the sales unit can sell. The sales budget is the sales estimate after it has been revised and adopted by those in charge of the budget program. Some concerns believe in setting the individual quota just below what they expect the salesman can reach, as they feel there is a desired psychological effect that is gained in beating the quota. Other concerns take the personal characteristics of the individual salesman into account, as they maintain that it is detrimental to the work of some salesmen to go past their quota. They feel that such men are rather prone to rest on their laurels. Their quota, therefore, should be set a little beyond what it is expected they can accomplish, thus keeping

them on their toes. Other salesmen get easily discouraged, and to encourage them their quota is purposely set low so that they can have the stimulus that comes from surpassing the quota set for them.

Making the Sales Quotas.—There is sometimes a difference in opinion as to who should set the sales quota. Some concerns add a certain percentage, more or less arbitrarily determined, to the sales of the past budget period and this becomes the quota for the new period. Other concerns have the salesmen set their own quotas, subject to revision by the sales manager. This latter method is coming more and more into use as management sees the wisdom of having the one who is to use the quota "write his own ticket" and thus assume responsibility for living up to it. As the salesmen become more familiar with budgeting matters the sales quota comes nearer and nearer to the sales estimate and is a truer picture of sales possibilities. If the salesman's estimate of what his territory can produce is to be an accurate one, he should be supplied with certain information from the sales office. The following extract taken from a description of the sales budget plan of the Hood Rubber Products Company [3] outlines a method which has brought quite satisfactory results.

Each salesman is furnished with a complete list of dealer customers, whether actual or prospective, in his territory. With the name and address of each actual customer is given, in case units by lines of product sold, the amount of goods he has purchased during each of the previous five years. Regarding prospective customers, information furnished by the salesman in his reports and that obtained from other sources are shown which will facilitate determination of his potential value as a customer during the next budget period. Adding to the information shown in this "key-book," so-called, his own knowledge of each customer's business, the salesman estimates the amount of each kind of goods he expects to sell. Breaking the salesman's estimate down into units per customer, the total estimate is considered to be more accurate than can be obtained by other ways. More exact information is available for estimating each dealer's business individually than for making a lump sum estimate for the whole territory. Also, since the territorial estimate is the sum of several hundred dealer estimates, individual errors tend to compensate one another.

Each salesman's estimate is turned in to his branch office, where it is reviewed and possibly revised by the branch manager in the light of his

[3] K. W. Stillman, Hood Rubber Sales Budgets, *Management and Administration,* Vol. 9, No. 5, p. 417.

better knowledge of the size of the territory, number of towns and dealers in it, past per capita business, general business conditions and other influencing factors. Each branch office totals the estimates made by its salesmen and turns the sum in to the home office. Here again the estimates are reviewed and, if revisions are necessary, they are worked out with the advice of the manager of branches at the home office so that the final estimate is satisfactory to all.

The above illustrates the making of a sales budget through co-operation of those who are in charge of enforcing the budget and those who are to use it. Estimated sales are given in volume as well as in value, as this information is needed by the production department in determining its production budget.

After the sales manager has drawn up an estimate of sales it is necessary to check this estimate against the production capacity of

SALES BUDGET FIRST QUARTER—JANUARY 1 TO MARCH 31, 1928										
Name or Symbol of Product	Previous Period		Estimates by Month						Total Estimate	
			January		February		March			
	Vol.	Value	Vol.	Value	Vol.	Value	Vol.	Value	Vol.	Value

Figure 129. Sales Budget Form

the plant and the financial condition of the company. If this is not done sales plans may be laid for selling articles in quantities which the factory is not equipped to produce, at a time when it is not desirable to expand or when the finances of the company are in such a condition that they could not bear the strain of the expenses involved. On the other hand, it may happen that the sales estimate is below that of former years due to business in general not being so active or to depression in that particular line of business. In order to utilize plant capacity and to maintain the plant and sales organization, it might be well to add another product even though the income derived from that product gives little margin of profit above caring for all expenses. It at least serves the purpose of holding the organization and of bearing its share of overhead which otherwise would have to be charged against the regular line of products. The sales

estimate in such cases must be changed to meet existing conditions before it can be approved and adopted.

Production Budget.—The production budget is drawn up to meet the estimated sales requirements, taking into consideration the amount of finished goods on hand at the beginning of the budget period and the amount that should be on hand at the close of the period, the production capacity of the plant and the cost of production. Under the last item comes an important factor, that of maintaining as even a rate of production as practicable throughout the year, as this not only tends to reduce the cost per unit but permits of maintaining a stable working force, promotes smooth running of the plant and increased plant efficiency. The production budget is gotten out for the full budget period but given in months for the sake of definiteness and clearness.

PRODUCTION BUDGET FOR MONTH OF JANUARY 1928						
Name or Symbol of Product	Net Required	Prod. Capacity	% Prod. Cap. to Meet Required	Estimated Cost		
				Labor	Material	Overhead

Figure 130. Production Budget Form

At this point there may be a difference of opinion. Some executives maintain that the estimates of the sales department cannot be used as a basis for production schedules unless they have been closely scrutinized and a large allowance made for undue optimism. There is no doubt that such was the condition in the past as many executives know from sad experience, but the sales manager and the salesman of today are of a different manner of thinking from those of even a few years ago. They still are somewhat optimistic, their work requires that characteristic in them, but it is optimism tempered with a good portion of common sense and a background of statistical information. The estimates they set today are not only those they would like to reach but they are those they expect to meet and are laying plans to meet, knowing that production is based upon those estimates and that it is up to them to make good the estimates they have set. With

the growing appreciation of the true function of budgets and with increased experience in their use, it is very generally found that sales budgets properly gotten out are surprisingly accurate. They are not absolutely accurate nor do they even very closely approach such a condition. That would be expecting too much. They are, however, approximately correct and are the best basis yet found for the scheduling of production.

Determining Production Estimates.—With the sales budget to tell what and how much the sales department expects to sell, the manufacturing department can schedule its production and can determine the estimated cost of labor, material and burden. The sales budget, although broken down into months, cannot be expected to tell exactly when the sales department expects to make sales. In some concerns in certain industries it may be possible, but in the majority of concerns the best the sales department can do is to designate what months sales are expected to be heaviest and when lightest. Usually, due to past records these seasonal fluctuations can be forecast with a considerable degree of accuracy, and many concerns plan to produce at a fairly steady rate of production, producing staple articles and storing the excess over current sales as a reserve to care for demand in periods of increased sales. The question of labor and material requirements will be considered under separate headings.

Estimated Burden.—This includes the estimated cost of indirect labor and materials and of the usual fixed charges. It is not within the scope of this text to discuss burden, the items included and the making of an estimate to cover it. It is well, however, to stress an important point in regard to the use of budgets as a factor in the control of burden. There are certain fixed charges which cannot be controlled by those in charge of production. There are certain other items ordinarily classed as fixed charges which can be at least partially controlled. For example, depreciation is a fixed charge. Proper care and upkeep of machinery and equipment will prolong their useful life and thus bring a lower rate of depreciation for them. Similarly with other items. If in a certain shop inflammable materials are used, a change in the method of storing them may reduce the insurance rate.

When a comparison is made of the actual accomplishment and expenditure against the estimate as given on the budget, burden

charges which are at all controllable should be listed so that the one in charge of operations under that budget can see wherein his department or shop is falling down and where improvement can be made. This in many cases would necessitate educating those in charge of operations in a working knowledge of accounting, but the effort ordinarily would be more than repaid by the results accomplished. One company reports that the change in the attitude of their foremen was amazing after they had learned the charges against their shops and the theories on which the shop charges are based. If a new item appeared on their budget or if a regular item were even ten dollars over what they considered it should be, the foremen asked immediately where the new item came from and why the charge against them was more than they had reason to expect it should be. Shop charges were reduced far beyond expectations.

Materials Budget.—An estimate should be made of all materials required to carry out the production schedule. This would include an estimate of the total amount of each item of raw material needed to produce the specified number of finished products and a schedule of when these materials would be needed. The latter is necessary for two reasons:

1. There should always be a sufficient supply of raw materials to meet production needs.

2. The amount of capital tied up in inventories should be kept to a minimum. When there is a planning section as there is in a plant operating under a production control system, the material estimate is prepared by that section.

Purchase Budget.—The estimate of materials required forms the basis for the purchase budget. The net requirements in a given item for any one month are found by adding to the production requirements for that month the amount considered necessary to have on hand at the close of the month and by deducting the amount on hand at the beginning of the month. In the suggested form for a purchase budget given in Figure 131 add columns 2 and 4, deduct column 3, and the result will be the net requirements as shown in column 5.

The purchase budget cannot be drawn up based upon production and inventory requirements alone, but must take into consideration the market conditions for each item or class of material purchased and

the financial condition of the company. The advantages to be derived from heavy or cash purchases must be foregone if they unduly strain the finances of the company.

The purchase budget is made out for the full budget period but given in months so as to show the financial commitments as definitely as possible. Column 6 shows the financial manager just what expense will have to be met due to purchases of past months, while column 7 shows the amount of money required to care for cash purchases. With the purchasing agent and the financial manager cooperating with one another, and with commitments known in advance, all possible purchasing advantages can be taken and yet no undue strain placed upon the finances of the company.

PURCHASE BUDGET FOR MONTH OF JANUARY 1928							
Name or Symbol of Product	Prod. Required for Month	Inventory Beginning of Month	Estimate Inv. at end of Month	Net Required		Est. Cash Disb'm'ts for Purch. Past Month	Est. Cash Disb'm'ts for Purch. This Month
				Vol.	Value		
1	2	3	4	5		6	7

Figure 131. Purchase Budget Form

Labor Budget.—The cost of labor is generally one of the largest items in manufacturing costs. It is necessary, therefore, that a careful estimate be made of the number and kind of workers required to produce the quantity of goods called for in the production estimate, and that the cost of such labor be figured as accurately as possible. As to who should get out the labor estimate depends upon the plant in question and its organization. In some concerns a planning section estimates labor requirements, in other concerns each foreman estimates his labor needs. In considering the labor budget, one thought should always be borne in mind. Labor is not a commodity that can be bought at a moment's notice. A plant cannot expect to have an efficient working force if employment in that plant fluctuates to any great extent. Labor of the right sort desires permanency in their jobs. Far-sighted manufacturers retain their good workers by keeping production at as even a rate throughout the year as practical working conditions permit. They know that skilled workers are not always available at a moment's notice.

Advertising Budget.—An advertising budget is drawn up for the budget period showing the exact distribution of the appropriation in regard to the product or groups of products to be advertised, the medium used and the date of issue. The use of an advertising budget necessitates careful planning before spending, and serves to promote that essential cooperation between sales and advertising and correlation of their efforts.

Plant and Equipment Budget.—The drawing up of a plant and equipment budget necessitates a careful consideration of the possibilities of the plant and its equipment in the light of present production plans and probable future developments. Such a budget covers plans for expansion of the plant, the extent, cost and time when needed; for the purchase of additional equipment, the items, their cost and when needed; for replacement of worn-out or obsolete equipment, the items, cost and date needed; for necessary repairs. The budget, in addition, would show the value of the plant and equipment at the beginning of the period, the estimated depreciation during the period, the estimated value of equipment disposed of and the amount realized and the value of the plant and equipment at the close of the period.

Expense Budget.—Expense budgets give estimates of the expenses to be incurred in maintaining the various departments of the business. Thus, there will be a sales expense budget, a purchasing expense budget, an engineering expense budget, a finance department expense budget, and so on. Under a complete system of budgetary control every expense which can reasonably be anticipated must be included in the proper budget.

Financial Budget.—The financial budget is an estimate of cash receipts and disbursements for the budget period based upon the budgets of all the various departments. It is at once apparent how important it is that the departmental budgets be drawn up with the utmost care and foresight, as the financial budget, which is a consolidation of all budgets, can only be as accurate as its component parts.

To meet the liabilities incurred in purchasing materials, in hiring workers, in meeting sales expenses, etc., a company may have to borrow money. The financial budget tells the one in charge of the com-

pany finances when he will need to borrow and how much. He can then plan when is the best time to borrow so as to obtain the lowest rate of interest and the best terms. Similarly, the sales budget with its estimates of cash receipts from sales is an assurance to the financial man that cash will be available to meet loans and other liabilities when they fall due.

Budgets are flexible. Changes are made from time to time. All changes result in either additional income or expense, and as such require the attention and, in many cases, the approval of the one in charge of the financial budget. For example, sales resistance may be unusually strong due to unforeseen adverse business conditions. The sales manager may come to the conclusion that he will either have to add to his sales force and so increase his selling expense or do a smaller volume of business than he has estimated on his sales budget. The former may involve expense which the company is not prepared to meet without additional borrowing from its bank, which may or may not be possible or wise; the latter may involve curtailment of production, cancellation of purchase orders, laying off some of the workers, etc. It is at once evident that the one in charge of the financial budget should be notified at the earliest possible moment of the possibility of any such change in the budget, and that he have a part in the making of any decision which will so materially affect the financial budget under which he is operating.

The financial budget is ordinarily given in three parts:

1. Estimated cash receipts covering each source of income and the amount expected to be derived from each source.

2. Estimated cash disbursements covering the amount expected to be paid out.

(a) In settlement of outstanding accounts and notes.
(b) In payment of accounts incurred through purchase of materials, supplies and equipment during the budget period.
(c) For advertising.
(d) In the operation of the factory.
(e) In the operation of the sales, finance and all other departments.
(f) In interest on bonds, dividends on stock, plant extension and other miscellaneous expenses.

3. Summary of estimated receipts and disbursements which shows in a concise form the financial condition which will result if the plans are carried out as outlined in the budgets drawn up. Such a statement gotten out by months to cover the budget period will show the cash on hand at the beginning of each month, the total receipts, total cash available, total disbursements during the month and the cash balance or shortage at the end of the month.

Estimated Balance Sheet and Estimated Profit and Loss Statement.—A few concerns are now making out in addition to the financial budget an estimated balance sheet and an estimated profit and loss statement which are intended to show the estimated financial condition at the end of the budget period. Such statements are of value in bringing out forcibly the effect which a proposed program will have upon the financial condition of the company if carried out, and may be of considerable value in arranging for credit or loans.

Benefits Derived from Budgeting.—Perhaps one of the greatest benefits of budgeting is that the making of estimates and later the check of actual performance against estimates set, make those in charge of the various budgets stop and take stock, as it were, of conditions and the status of work in their charge. The average executive and supervisor is too close to his job to get the necessary long-range view of his work. Unless something necessitates that at stated intervals he study conditions, the progress that is being made and the plans for the future, he is very likely to be so engrossed with everyday problems that he unknowingly allows his department or shop to drift.

Budgeting necessitates looking ahead and planning. In times of increasing business the concern which has not availed itself of the aid of budgeting may suddenly find itself unprepared. It may be without sufficient raw materials to meet increased demands. To obtain the necessary raw materials, if they are available at all, may mean that top prices have to be paid, thus reducing profits. Labor may be short. Workers hired in a hurry are not always the most desirable from many standpoints. Similarly with other adverse conditions which result from the lack of planning. If business is declining, the company may suddenly, and often too late, realize that its stocks are piling up with little or no chance of moving them. The inevitable

result is the taking of a loss and the disruptive, hasty and haphazard laying off of workers. Where a budget is employed control is closer, and increasing or declining demand is forecast, at least approximately. Preparation is made in advance to care for increased production and sales or calm and intelligent curtailment of all activities, whichever course conditions demand.

Budgeting is a big factor in the coordination of the activities of the various departments of a business. Before departmental budgets are approved and adopted they are considered in the light of their effect upon the work, not only of the particular department but of related departments and the business as a whole, and of the way in which they will fit in with and facilitate the plans of other departments. Without such coordination of plans and estimates, each department head works for the good of his own department, often irrespective of the effect upon other departments. With budgeting, therefore, a means is provided whereby all executives and their subordinates are working together, each doing his part in carrying out plans developed and operated for the best interests of the company as a whole.

Budgets Fix Responsibility.—Budgets aid materially in the fixing of responsibility. Thorough budgets plans are made for the future. These give the subordinate a definite idea of what his superior expects of him. He knows that if he lives up to his budget he is doing his part, that if he falls down through conditions within his control, he must expect to be held responsible. For example, a division head may submit to his superior his estimate of operating expenses for his division. When approved and accepted, his responsibility is definitely fixed. He, therefore, will be more careful in authorizing expenditures and he will challenge the necessity of many items. If he were not operating under a budget he would very probably not appreciate the sum total of such expenditures nor feel the same responsibility. Likewise, without planning expenditures in advance and checking actual expenditures against estimates, management would not have the means for judging the correctness of expenditures and of fixing responsibility for them.

Limitations.—The term "budgetary control," as most industrial men will agree, is an unfortunate one. Budgets do not control. They do not take the place of executives nor can they ever be expected

to do so, no matter what improvements are made in methods or procedure. Budgets are merely a tool of management, although a very valuable one. Too much must not be expected of them. Like any tool, their value to a considerable degree lies in the use made of them and in the ability of those using them.

CHAPTER XXXIII

INDUSTRIAL WASTE AND ITS REDUCTION

The Burden of Waste.—The appalling amount of needless waste found in industry is a burden alike to owners, management, workers and the buying public. Waste is the greatest obstacle in the path of progress. It is the responsibility of each and every individual to do his part in removing this unnecessary burden as it is only by the united efforts of all that worthwhile results can be accomplished.

To attempt to make an inclusive study of the subject of industrial waste and its reduction would require volumes. The following discussion is intended to be merely indicative of the innumerable sources of waste, to open the eyes of the student to the waste that is running rampant and to point out the many opportunities for checking and ultimately eliminating this unnecessary burden. The United States has great resources but they are not inexhaustible. We must make maximum use of them or we endanger our future welfare and prosperity.

Relative Responsibility.[1]—Waste in industry is attributable to:

1. Low production caused by faulty management of materials, plant, equipment and men.
2. Interrupted production caused by idle men, idle materials, idle plants, idle equipment.
3. Restricted production intentionally caused by owners, management or labor.
4. Lost production caused by ill health, physical defects and industrial accidents.

More than 50% of the responsibility for these wastes can be placed at the door of management, less than 25% at the door of labor, while the amount chargeable to outside contacts is least of all. Management has the greatest opportunity and responsibility for eliminat-

[1] Abstract from "Waste in Industry" by the Commission on Elimination of Waste in Industry of the Federated American Engineering Societies, McGraw-Hill Book Company.

ing waste in industry. It must be recognized, however, that if management is to meet this responsibiilty fully it must have the cooperation of labor.

Forms of Industrial Waste and Suggestive Methods of Waste Reduction.—As management bears the greatest responsibility, emphasis will be placed upon those factors that make for industrial waste which it is the duty of management to so direct and control as to eliminate many fruitful sources. This management can only accomplish through the application of the principles of scientific management to all phases of a business. Through the following illustrations it is intended to touch lightly each phase and to show how scientific management can materially aid in waste reduction, and how the lack of it is responsible for the present-day evil of rampant waste with the resultant high costs of production and distribution.

Spasmodic campaigns from time to time against waste have their effect. They stimulate interest and bring out many possible economies, but wastes constantly creep in and it is only by continual watchfulness of processes, of utilization of materials, equipment, labor and power, of analysis of present wastes, the causes back of them and the cost of their elimination that real economy of operation can be secured. Waste reduction is a question, first, of education of those responsible and, second, of the carrying out of a careful and consistent program. In considering the subject of waste it should be borne in mind that waste is but temporarily reduced when a wasteful condition is corrected unless the underlying causes of that wasteful condition are themselves studied and removed or corrected.

Chances of a New Enterprise.—Records of business failures show that the chances are against the success of the average new enterprise. Business failures are a prolific source of waste, the loss from them affecting not only those individuals directly concerned but, indirectly, the entire community. This needless waste could be eliminated largely through careful and thorough analysis of all influencing factors before starting an enterprise.

The overcrowding of the merchandise field is a case in point as it is the cause of enormous waste, and yet each year sees thousands of new retail stores coming into existence and struggling to survive, with many of them losing out and untold millions wasted. A careful analysis of conditions before entering the field would have revealed

this overcrowding in many cases, especially in view of the fact that statistics show that there is a retail store for every 111 people in the United States and a wholesale establishment for every 32 retail shops.[2] This does not mean that there are not many splendid opportunities for new enterprises in the merchandise field. The opportunities are there, but in every case a careful analysis should be made to make sure that the enterprise in question will be the means of grasping an opportunity that has arisen.

Waste Due to Poor Location.—Waste, with resultant high cost of the finished product and low profits, is frequently due to poor location. The manufacturer who locates at a considerable distance from the source of his raw materials and, therefore, has to add heavy freight charges to the cost of his materials is hardly in position to compete with other manufacturers more favorably located. Plants in which large sums are wasted annually in transportation charges or excessive rents, or where production is continually hampered by lack of an adequate supply of competent labor or power will profit in many cases by relocation at a strategic point. Relocation, however, is an expensive and sometimes quite disruptive process and should only be followed in cases of true necessity. In such cases a careful analysis of the company's needs should be made and the new location selected in respect to how closely it will meet those needs. In many instances the employment of a competent industrial engineer who is an expert in the planning and laying out of industrial plants will prove advisable and will tend to minimize the costly adjustments and changes which develop as an aftermath of relocation when the plant is put into operation.

Wastes due to poor location are among some of those most difficult to combat. Relocation is in many cases impossible. The company may own its plant and cannot dispose of it except at a ruinous sacrifice. Production must, therefore, go on under a heavy handicap, with chances of but mediocre success at best. Management can eliminate or at least very greatly reduce the wastes incident to poor location by giving sufficient thought to the problem beforehand.

Waste Due to Building Construction.—Waste under the heading of building construction would include waste due to high main-

[2] "Inefficiency and Waste in American Industry," by Benjamin P. Chass, *Industrial Management,* October, 1925.

tenance cost of cheap, flimsily constructed buildings, to excessive overhead charges due to unnecessarily expensive construction, to retarded production and increased cost of operation caused by unsuitability of buildings for the purpose, to restricted production through lack of provision for necessary expansion or to excess provision for expansion with resultant burden of high overhead.

A building once constructed is a fixed structure, therefore it should be carefully planned in order to see that every manufacturing requirement is met, that the buildings erected provide for economy of operation and upkeep, that the burden of overhead will be within reason, and that due consideration is given to the need for future expansion and to the safety and comfort of the workers.

Improper Layout.—Fruitful sources of waste found in many if not the vast majority of plants are the unnecessary delays, retracing of steps and rehandling of materials due to improper layout. In many cases such conditions can be practically eliminated through rearranged layout to provide for efficient sequence of operations with the flow of work in as straight a line as practicable and with a minimum of material handling, cases having been known in which labor cost alone was reduced 40% to 50%. In one concern, in the machining and grinding of camshafts, out of a total of 34 operations there were 18 doubling back, with resultant loss of time and misplaced materials. This wasteful condition was corrected and the work flowed in a straight line after the layout was rearranged.

Poor Lighting.—Poor lighting breeds inaccuracy, increases waste due to spoilage, causes fatigue and slowing up of production and, if used for any length of time, results in actual injury to the eyes of the worker. The economic waste due to poor lighting is rarely fully appreciated. Proper lighting with uniform light in sufficient quantity and in the form most suited to the particular work to be done is an essential factor in industrial waste reduction.

Wasteful Use of Equipment.—Modern machinery revolutionized industry. A few maintain that the efficiency of machines is a cause of waste as thousands of workers are thrown out of employment. This is a fallacy. Modern machines turn out more and frequently a better product at considerably less cost, thus putting the product within the reach of the masses and serving to turn loose

workers, not to lie around idle, but for other necessary productive work. The waste comes from the worker in not fitting himself for other work or in not wanting to do work which is open to him and from capital in not providing more work. Any other argument is an argument against progress. Modern machinery on the farm takes the place of many farm hands, but still the continual cry is for farm labor, thousands of acres are unworked and food prices are high. The same condition exists in industry. Competent labor is practically always in demand. The use of machinery broadens the industrial field and opens up new lines for development.

Wasteful methods in the use of machinery and in the selection of machinery not suitable for the purpose are two sources of waste which management can largely eliminate. There is always a best way of performing a task. It is the duty of management to determine which is the best way and to see that labor is taught and follows this method. Prerequisite to the use of proper methods is the selection and use of the correct class and type of machines and equipment. To cite another actual case—in a large industrial concern turning out a variety of products, machines not then in use were utilized to turn out a new product. The result was a loss on every article produced. Upon investigation and the installation of a new, comparatively inexpensive machine the product was turned out at a very satisfactory margin of profit.

To the man who is interested in production there is always a temptation to buy new machinery. The machines in use may be all right but they seem out of date in comparison with the new machines with their greater speed and capacity. Unless one is on one's guard against this very natural temptation and considers the purchase of a new machine only when such equipment is actually needed or when its use will so reduce manufacturing costs that the purchase is warranted, capital will be wasted through buying new equipment and scrapping equipment which is still abundantly capable of meeting all needs.

The writer has in mind one concern in which the works manager was very enthusiastic over a new type of machine which would turn out double the quantity of the machine then in use. The new machine cost ten thousand dollars. Fortunately for the company, before purchase could be made there had to be a consultation of certain department heads to consider the matter. At the meeting at which practi-

cally everyone seemed to catch the enthusiasm of the works manager, the head of the engineering department asked a simple question which put quite another light upon the matter and stopped all thought of purchase. He simply asked what would they do with all the output of the machine. Production to be economical must be balanced. If the output of one machine or production center is doubled, then the output of the machine or production center which utilizes the output of the first must likewise be doubled or one of two things will happen—the first will have to stand idle half of the time or stocks will pile up which cannot be utilized. Care must be exercised, therefore, in purchasing new or additional equipment, or costly wastes will soon pile up.

A factor in the reduction of such wastes is to do as the company above cited did, that is, have a committee to pass upon and approve all purchases of equipment before they can be made. On this committee should be the head of the shops or operating division, for it is his responsibility to get the work out, therefore he is interested in having the best equipment he can possibly have; the head of the engineering department, as he knows of any contemplated changes in design of parts or products which might affect the usefulness of the equipment under discussion; the head of the maintenance division, for he is the one responsible for maintaining equipment. The latter knows from his experience that some machines cost more to maintain and are more subject to wear and breakage than others, therefore he views the machine under considerations from that angle. Similarly, the purchasing agent should be present, as he knows what purchases the company is then under contract for and if the purchase is made he will do the purchasing and will want to be familiar with the machine and its use so as to be able to talk intelligently and to endeavor to get the most favorable price and terms.

The above warning to consider carefully from all angles the advantages to be derived from the purchase of new equipment before purchase should not be misconstrued to infer that it is advocated that a company operate their present equipment as long as it remains in working order. In many instances enormous gains are made by buying new equipment and scrapping present machines which are still operating practically as well as they did when they were new. This is due to the great improvements that are continually being made in certain lines of machinery. One of our large mass production

plants, already with equipment rated as some of the finest on the market, spent nearly a quarter of a million dollars perfecting a special machine. This would seem a great amount of money and one would think that they could never expect to realize the amount put into it, let alone make a saving through its use, yet the use of that machine when perfected resulted in a saving of about $1,500 a day in operating expenses.

Unnecessary Variety in Design.—Many manufacturers maintain that overdiversification is caused by competition, whereas, in most cases, if manufacturers would put their plants on a more efficient basis, would drastically reduce the number of sizes and styles and make those that they produce the best that can be made for the market to be met and, at the same time, hold down costs, the results would be less waste, more profits, competition ably met and satisfied customers. In such a simple article of wearing apparel as children's socks there are innumerable and everchanging styles in a seemingly endless variety of colors and shades. Much of the ingenuity needed to design all this unnecessary variety is utterly wasted; the buying public does not demand them nor want them. In the rush of falsely stimulated competition plants are overproduced, the market becomes flooded, plants must shut down, workers are out of work and a great bulk of the goods is frequently sold at a loss. Competition is a powerful stimulant to industry, but if carried too far or wrongly applied it becomes a prolific source of waste and a destroyer of the very industry it served to build up.

The unnecessary variety of commodities produced is one of the greatest factors in industrial waste. The solution of the problem is to eliminate unnecessary variety, to stop catering to whims and fancies and to concentrate on fewer items. Simplification and standardization are two major factors in waste reduction. Much has been done along this line by the Department of Commerce at Washington, the Federated American Engineering Societies and the Chamber of Commerce of the United States through its Fabrication Production Department, working in cooperation with progressive leaders in industry. For example, the number of sizes of bed blankets was reduced from 78 to 12 at a general conference attended by representatives of manufacturers, distributors and consumer organizations. The standards adopted provide 6 sizes for single and 6 sizes for double

beds and have application to wool, wool mixed and cotton blankets. Similar simplification and standardization have been carried on in a number of industrial lines. There are, however, many lines which have as yet given very little, if any, serious consideration to the possibilities within their own fields. In a study of nearly 400 separate and distinct commodity lines, the Fabricated Production Department of the Chamber of Commerce has found virtually none which are not more or less amenable to simplification.[3]

There is on the part of many a misconception of what simplification and standardization in industry imply. Simplification and standardization do not tend to reduce all products to a common pattern, nor do they stifle individuality. They merely tend to select the best in industry and to concentrate on the items, types or sizes selected until something sufficiently better is found to warrant change.

Simplification or standardization is not confined solely to the completed product. In fact, it frequently happens that the finished product does not lend itself readily to any such procedure. However, there are a number of possibilities for variety reduction, a few of which are:

Size	Component Parts	Capacities
Shape	Purchased Parts	Performance
Style	Raw Materials	Terminology
Design	Fittings	Specifications
Crates		Color
Cartons		Finish
Labels		Brands
Containers		Grades

Each of these offers a field for profitable investigation, and there probably is no industrial establishment wherein some application for simplified practice cannot be found.[4]

Cost Accounting a Factor in Waste Reduction.—Only by accurate cost figures can efficiency be tested and rated, whether it be the efficiency of an individual worker, a machine, a department or the entire plant. An ingenious system or a special machine may appear to be the last word in efficiency, while in reality its operation may be a source of waste. Cost figures are the true test and yet the majority of industrial plants are not taking the advantage that they should of

[3] Abstract from Bulletins No. 29 and 31, Chamber of Commerce of the United States.
[4] "Simplification and Standardization—A Means of Reducing Industrial Waste," Fabricated Production Department, Chamber of Commerce of the United States, Washington, D. C.

cost accounting. Without cost figures there can be no accurate knowledge of conditions, hence wasteful methods go unrecognized and uncorrected. Taking full advantage of the many benefits to be derived from a simple yet adequate system of cost accounting spells the difference to many a concern between wasteful methods and little or no profits on the one hand, and efficiency and progress on the other.

Waste in Purchasing.—Uneconomic and speculative purchasing is responsible for a goodly share of the industrial waste that can be laid at the door of management. The first step in the reduction of wastes due to poor buying is the centralization of the purchasing function in the hands of an executive who is specially fitted for the work. The second step is the drawing up of specifications for all materials, parts and supplies that are to be purchased and the third step is to budget purchases based upon the demand of the production schedule and with due consideration to market conditions and the financial condition of the company.

Buying in large quantities to obtain an apparent saving through quantity discount is frequently a costly and wasteful procedure. A large automobile manufacturing concern found after changing the model of their car that they had in stock three-quarters of a million nuts and bolts to match which they could not use on the new model. As the former model only required two of this particular size and type of bolt, it is at once apparent how short-sighted and wasteful the purchasing policy was. Upon a thorough study of conditions it was found that the nut and bolt situation was typical of their general purchasing. A reorganization of the purchasing department and the installation of an adequate system of material control have brought about an enormous reduction in losses due to wasteful purchasing and obsolescence.

One of the big wastes under the heading of purchasing comes from the buying of cheap materials through a false idea of economy. The quality of material should be of a grade which best lends itself to the manufacturing processes, meets the demand of the market and permits of sale of the finished product at a fair margin of profit. A cheap grade of material may necessitate more hand labor or more machining, the use of additional tools, changes to overcome defects and increased inspection. Ordinarily, the cost of labor, machine time and overhead is far greater than the cost of materials, therefore, the

apparent saving in purchasing cheap materials frequently entails waste rather than saving.

Industrial Relations.—The magnitude of the yearly waste attributable to labor turnover is beyond conception. There is not only the loss to the workers and indirectly to the community through the lessening of their buying power, but the cost to the companies affected in hiring new workers to take the place of those who have been fired or have left voluntarily. This cost at a conservative estimate can be put at from $50 to $100 for the average industrial concern, and frequently at a considerably higher figure, depending upon the position to be filled. As it is not unusual for a company to have a rate of 100% labor turnover in a single year, the waste due to this cause is enormous.

The high rate of labor turnover is due to a considerable extent to seasonal production. It is the part of management to lend every effort toward uniformity of production, offsetting slack seasons by producing during such periods standard products or products in demand in the off season of the regular line of product. This is a most important factor in the solution of the problem of securing an efficient, permanent working force. Other influencing factors are selective employment, training of employees, a fair system of wages and incentives, good working conditions, fair and competent foremen and those other factors which gain for a company the reputation among workers of being "a good place to work."

Maintenance.—The old adage "a stitch in time saves nine" applies equally well to the factory. There is a multitude of inconspicuous wastes, such as that caused by friction due to lack of or improper lubrication, to loss of power due to shafting being out of alignment, or to the failure of belts to transmit adequate power and a hundred and one other wastes, practically all of which could be eliminated through regular inspection, cleaning, oiling and the making of minor repairs when needed. If such minor repairs are not made, a loose nut or a defective or weak part, a stretching or loose belt, all will go unnoticed and uncorrected with a resultant breakdown or belt failure which is not only annoying but expensive.

A competent maintenance division more than pays for itself many times a year through maintaining the plant at all times in ef-

ficient working order. With maintenance work "the ounce of prevention" is more than worth "the pound of cure." The manager of a textile mill frequently complained of the unreliability of their expensive and up-to-the-minute looms but did not realize for a long time that it was not the fault of the looms but their own inefficiency in not having an adequate maintenance division to regularly inspect and care for the looms so as to avert breakdowns.

Plant Protection.—Much of the economic significance of fire losses is lost sight of. A building and equipment destroyed by fire has to be replaced. This takes labor away from productive work. Similarly, the employees of the company that has suffered a fire loss are also affected as they may not be able to secure a job to tide them over during the period in which the new building is being erected and equipped. Likewise the consumer pays. One might say, "But the building was insured and the insurance paid the cost of rebuilding." Even so, the consumer pays the insurance premiums, as all costs are calculated and covered in the price the consumer pays for the product. In a community where fire risk is unusually high, or where the plant insured has suffered a number of times from fire loss, the rate of insurance charged is naturally considerably higher than it is in the case of another company which for various reasons is not subject to as great a fire hazard.

Management can play an important part in fire prevention. This thought should be borne in mind from the very inception of the enterprise. Certain localities, due to congestion of buildings or nature of processes of manufacture carried on there or materials used, are subject to greater fire hazard than others and, therefore, are not desirable places in which to locate. Similarly, certain types of construction of buildings reduce the danger of fire loss. After the plant is located and built, management still has a large part to play in fire reduction. Accumulation of dirt and rubbish is credited with being the source of 50% of industrial fires. This factor management can very largely eliminate by seeing to it that the plant and grounds are kept in a clean and orderly condition and by allowing rubbish to be placed only in metal containers. Organizing employees for fire protection, educating workers in fire prevention and in what measures to take in case of fire, supplying adequate fire-fighting equipment, and seeing to it that it is always kept in good working

condition, these are some of the ways in which management can do its part in minimizing loss due to fire.

Inspection.—Uniformity of quality of products is essential if a company expects to retain its present customers and extend its selling field. The reputation of a company depends to a very considerable extent upon the quality of its product. The finest selling organization and the most extensive advertising campaign will be of little permanent avail if the quality of the product is not maintained. In fact, it will be practically all wasted effort and wasted money for, while it will probably bring in initial orders, the business will stop there. Initial orders ordinarily are costly to obtain. It is repeat orders that bring the real profits. These cannot be obtained unless the quality of the products warrants them.

To maintain a set standard of quality requires inspection of raw materials upon receipt, inspection at stated points during the manufacturing process and final inspection of the finished product before it is shipped to the customer.

Inspection not only safeguards the quality of the finished product but, in addition, prevents losses due to receipt of inferior, unsuitable or short count materials, and of labor and materials due to spoilage and to additional work being put on defective or poor workmanship parts. Adequate inspection, therefore, is essential to waste reduction.

Production Control.—The lack of production control is one of the large waste factors and one which is present to a marked degree in the majority of plants. In fact, there are comparatively few plants that have yet realized the importance of production control and have taken the effort to develop and install an adequate system. The result is that the flow of production is not controlled, there is congestion of work at some points, idleness at others, with a resultant holding up of production and a multitude of small wastes which aggregate large sums and show up most forcibly on the balance sheet. The wastes directly attributable to a lack of adequate production control are numberless; the following merely gives a glimpse of their magnitude.

STANDARDS.—Under the heading of the setting of standards comes time and motion study work. Unfortunately, a great many if not the vast majority of managers and workers do not have the proper conception of time studies. To them their use is restricted to

the narrow field of setting piece rates. Time studies made by competent time study men include, first of all, a study of each particular job from the standpoint of betterment of working conditions and improvement in methods of operation, and then the setting of piece rates after the necessary changes have been made. Accurate time studies pave the way for the elimination of waste due to unnecessary or inefficient methods of operation and have been known in many cases to double or triple production on the jobs studied.

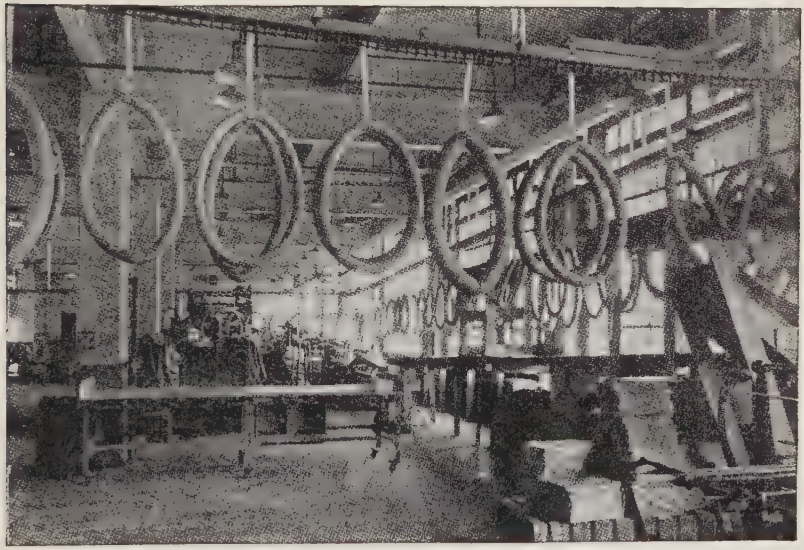
Scheduling and Dispatching.—With the parts list, routing sheets and the standard times of production as a basis, a schedule can be drawn up showing when each required part should go into production and the work dispatched on the date set. Absence of such scheduling and dispatching and the incident follow-up to compare actual results with standards set results in waste due to causes of slowing down of production going unrecognized and uncorrected and to parts not being finished at the time needed for assembly. In a large eastern concern manufacturing machine tools, assembly of a lot of 65 machines was held up due to a small part not going into production in time so as to be completed when needed. The result was waste due to idle men, to the assembly room being clogged with partly assembled machines and parts, to the extra effort, confusion and interruption of other work in rushing production on the needed part and to the extra expenditure in getting through a special rush shipment to a customer whose production was being held up by non-delivery of machines when promised.

When production is not properly controlled one of the chief sources of waste is the faulty assignment of work. A drilling operation may be assigned to an ordinary drill press where the operation may take ¾ of a minute, while it should have been assigned to a sensitive drill press where the operation would take but a half minute. The saving of a quarter of a minute does not sound very much, but on a lot of 500 pieces the saving amounts to two hours in working time alone, a considerable item.

Material and Tool Control.—Chief among the wastes that can be largely eliminated through adequate material and tool control is production delay caused by lack of materials and tools. An adequate system of material and tool control provides facilities so that the

proper tools and materials in proper quantity are at the assigned machines and workplaces on schedule time so that the workers will not be delayed when the order is given to commence work. Lack of such provision results in the foreman or worker wasting time in chasing up materials and tools, in idle machines and a general slowing down of production and last, but of decided importance, in a lowering of morale of the working force.

No discussion of reduction of industrial waste would be complete without mention of the waste incurred in unnecessary handling of



(Courtesy of Cleveland Crane & Engineering Co.)

Figure 132. Chain Conveyors Save Money and Labor in Tire Plants [5]

materials and in the use of hand labor rather than material handling equipment. This fact is most forcibly driven home to us when we consider that although coolie labor in China receives less than 1/30th the pay of common labor in the United States, coolie labor in China is at least twelve times as expensive as an equivalent amount of mechanical energy for the handling of materials in America.[5]

Figure 132 shows a chain conveyor installation in one of the large tire factories. Such an installation is inexpensive, easy to in-

[5] George E. Hagemann, Cutting Your Handling Costs, *Manufacturing Industries*, July 1927, p. 19.

stall, very cheap to operate and maintain and is out of the way, so it does not take up space needed for productive machinery and will pay for itself in a year or considerably less where it supersedes hand labor.[6] The kinds and types of material handling equipment are many and varied to fit the varied needs found in industry. The material handling equipment to select is an individual problem. In deciding to install material handling equipment one thought should always be borne in mind. There is a wealth of material handling equipment on the market; most of it is very effective in reducing wastes in handling. If one is not careful one becomes very enthusiastic and buys first one type to overcome one difficulty, then another type to overcome another difficulty, and so on. Cost of equipment piles up and there is more equipment than is truly necessary. The safer plan is to study the entire material handling problem of the plant and then select that equipment which is necessary. It will usually be found that there is certain equipment which is flexible enough to meet several needs and the equipment as finally installed will lend itself to smoother and more economical plant operation.

Operation.—Some of the costly wastes under the heading of operation are those that can be directly attributed to poor foremanship. In a gear shop where the foreman was of the old type, content to drift along and suspicious of all new methods, his attitude was sensed by the workers and conditions finally became so bad and assembly was so frequently held up by lack of sufficient gears that an investigation was made and the foreman dismissed. A more energetic and capable foreman with the same working force so corrected the wasteful conditions and improved the morale of the shop that operaing time was cut in half and the gear shop was put on an equal basis with the other shops.

Among the wastes included under the heading of operation are labor wastes due to idleness and to misdirected or unnecessary labor. Management can do its part in reducing such wastes by providing capable foremen, giving them whatever training they need and relieving or supporting them by providing the necessary staff divisions.

Some concerns have secured very worthwhile results in waste reduction by enlisting the cooperation of the workers through exhibits, posters, articles in the company paper, etc., and by inviting the workmen to make suggestions. The Midvale Company drove

[6] George E. Hagemann, *op. cit.*

home to the workers the value of white pine that was being wasted by comparing the price of the lumber with that of sugar, a commodity in everyday use in the workman's home. The price per pound of the quality of white pine used in the pattern shop figured out approximately that of a pound of sugar. This cost was something every workman could appreciate. Next, it was figured that approximately 400 lbs. of white pine reached the scrap bin every two or three days, costing the company $27.20. As a further encouragement to reduce waste some concerns reward those who make worthwhile suggestions for waste reduction, while others give a bonus for reducing scrap.

Selling.—The amount of waste chargeable to the selling end of a business is rarely appreciated. Where competition, low profits or actual loss necessitates cutting of costs it is the manufacturing department that ordinarily bears the brunt. This is due to the fact that accurate cost figures for sales ordinarily are not known. The average company thinks of sales in terms of volume and sales price rather than the cost of making sales, entirely overlooking the fact that enormous volume if gotten at too great a cost, may be the cause of a loss rather than a profit. An adequate cost system for sales, while not an end in itself, will, if intelligently used, result in a considerable reduction in the cost of making sales by pointing out wasteful methods and needed changes. Such a system to be of greatest value should be designed to show in the simplest form practicable the relative value of territories, the comparative sales ability of each salesman and their cost of making sales, and the selling cost and profit or loss by lines of products.

Salvage.—In a plant of almost any size there is opportunity for economy through the operation of a salvage section to which can be sent for reclamation and disposal obsolete and worn materials and scrap of all kinds. Even in a plant where the services of perhaps only one man would be necessary for salvage work, the economies are often surprisingly large. Many concerns feel that they have not sufficient quantity of scrap to make it worthwhile to do anything with it. They, therefore, let it accumulate and when the quantity becomes large enough to be in the way of productive work or when the spirit of clean-up strikes them they sell it by lot, glad to get rid of it and feeling that whatever they receive is so much gain. It is from such practices that the junk dealer thrives and accumulates a tidy fortune,

as many of them do. Other concerns go a step farther and sort their scrap, thereby receiving a better price, but even at that they are usually giving far more than they realize and receiving but a fraction of the true value.

Many articles needed in the shop can be made at small cost from worn out, damaged or discarded materials; similarly many parts, tools, etc., can be reconditioned at a profit. Materials discarded by one shop may be used or made into articles required by another shop. Broken tools such as hammers, wrenches, saws, braces, bits, drills, planes, dies, etc., frequently can be repaired or reworked and put back into service at a good margin of profit over what a similar new article would cost.

Metal chips and turnings, cuttings, small pieces, etc., of one kind or another (zinc, brass, malleable iron, forged steel, cast iron, etc.) should be sorted and sold by weight. So that unnecessary work will not be required in the salvage room, it is advisable to have separate containers in the shops into which the different kinds of metal can be placed. Where the quantity of metal scrap is sufficient to warrant its purchase, a press can be used to compress the metal scrap into cubes of a suitable size, as the metal cubes have a higher market value.

The materials in an industrial plant which can be profitably salvaged are many and varied. Lumber from boxes from incoming shipments, rubber, cotton, old paint, belting, oil reclaimed from chips and turnings are only a few examples in a wide field.

Coordination of Activities.—Lack of coordination of activities is the basic cause of much of our industrial waste. Those in charge of a given activity in a business are very naturally interested in the promotion of that activity and are rather prone to consider it as independent of other activities carried on within the same business. Thus, there is a good deal of wasted effort through lack of harmony. The main problem of those in charge of a business is the development of a strong, properly functionalized organization and the fostering among that organization of the spirit of wholehearted, intelligent cooperation—of working together to a common end. This necessitates clear-cut lines of authority, definite fixing of responsibility, and the elimination of departmental jealousies. This latter can be brought about largely by the attitude and actions of the general manager aided by a well-developed budget plan to give unity of action.

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V [illegible] inspection [illegible] receipt

VI definite [illegible]

VII adequate [illegible] issue, inventory & accounting

VIII strict control of [illegible]

IX [illegible]

X definite identification

XI circulation [illegible] system

XII centralization authority

XIII checks and [illegible]

RP-119

Organization Chart

to now

Make picture of jobs

Question of Function

Define item as "Product analys

Intro
a. concl
b. Limiting factor
c. plan of attack

Herbie Griffin
Keith Stanager
Bobbie Hatfield